SELECTED

SESOURCESRESOURCES ABSTRACTS



VOLUME 19, NUMBER 1 JANUARY 1986

W86-00001 -- W86-00307 CODEN: SWRABW **S ELECTED WATER RESOURCES ABSTRACTS (SWRA)** is produced by the Geological Survey, U.S. Department of the Interior, and published monthly by the National Technical Information Service (NTIS), U.S. Department of Commerce.

SWRA is available to Federal agencies and their contractors or grantees in water resources research upon request, citing contract or grant number and sponsoring agency. Write: Water Resources Division, U.S. Geological Survey, MS 425, Reston, VA 22092. The SWRA Journal is also available on subscription from NTIS, 5285 Port Royal Road, Springfield, VA 22161. Annual subscription rates for the North American Continent are: Journal only, \$115, Journal and Annual Indexes, \$145; Indexes only, \$50. Other addressees, write for prices.

Some documents abstracted in this journal can be purchased from NTIS. Price codes are given in the entries and a current code-price conversion table is printed on the outside back cover. Other documents are available from originating organizations or authors as indicated in the citation.

SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey U.S. Department of the Interior

VOLUME 19, NUMBER 1 JANUARY 1986

W86-00001 -- W86-00307



The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the Water Resources Thesaurus. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific Information Center U.S. Geological Survey MS 425 National Center Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

SPATIALLY VARYING RAINFALL AND FLOODRISK ANALYSIS, Massachusetts Inst. of Tech., Cambridge. For primary bibliographic entry see Field 2E. W86-00012

NONLINEAR TIME-VARIANT CONSTRAINED MODEL FOR RAINFALL-RUNOFF, Arkansas Univ., Fayetteville. Engine

Arkansas Univ., rayestevine. Engineering Experiment Station.
B. Datta, and D. P. Lettenmaier.
Journal of Hydrology, Vol. 77, p 1-18, 1985. 3 Fig,
7 Tab, 11 Ref. State of Washington Water Research Center project C-00234.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Constrained linear system model, *Non-linear models, Hydrologic models, Precipitation, Runoff, Mathematical studies, Statistical analysis, Hydrologic models.

Hydrologic models.

Models of the rainfall-runoff process can be segregated into two classes: those based on input-output (black box) techniques, and those based, directly or indirectly, on the laws of physics. Both approaches have limitations and advantages. A combined model was developed which incorporates an approximated description of the physical process to estimate effective precipitation and uses the input-output estimation procedure of the constrained linear system (CLS) model to relate effective precipitation to runoff. Certain problems of poor calibration and prediction encountered with the CLS model were significantly reduced by using estimated effective precipitation in place of actual precipitation. Use of the precipitation preprocessor with the CLS runoff model effectively incorporates nonlinear and time-variant dynamics without the necessity for multiple-parameter vectors and antecedent precipitation thresholds required by the original version of CLS. Additional refinements, including time variability of some of the parameters, can easily be accommodated in the new formulation. (Author's abstract)

VARIOGRAM IDENTIFICATION BY THE MEAN-SQUARED INTERPOLATION ERROR METHOD WITH APPLICATION TO HYDRO-

LOGIC FIELDS, Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble. T. Lebel, and G. Bastin. Journal of Hydrology, Vol. 77, p 31-56, 1985. 10 Fig. 10 Tab, 23 Ref.

Descriptors: *Variograms, *Mean squared interpo-lation error method, *Interpolations, *Hydrologic models, Model studies, Hydrologic data, Interpola-tion error, Statistical analysis.

tion errror, Statistical analysis.

Real-life applications of BLU (best linear unbiased) interpolation in random fields, require, in most cases, a preliminary identification of a parametric model for the variogram of the field of interest. The variogram identification can be performed by minimizing a functional of a set of observed interpolation errors; the 'mean squared interpolation error' (MSIE) method is such a method for variogram identification. A theoretical analysis of the MSIE method was performed under the realistic assumption that the parametric variogram model is only an approximation of the true-field variogram. A general asymptotic property was demonstrated which does not require any specific assumption on the probability density of the field. In a piezometric field application, the variogram model was a basic tool for the contour mapping of the water level. The MSIE criterion is an efficient tool to discriminate between alternative variogram models and, in this case with scarce data, the models obtained with the MSIE method can differ substantially from those derived from the experimental variogram: a theoretical analysis of the robustness of the various identification methods with

small data sets would be very useful. In a rainfall field application, the variogram model was needed to calculate mean areal rainfall variances and mean areal GRADEX. A global climatological variogram was identified: a very large data set was available and the best model was very close to the experimental variogram. An interesting cross-validation result is that the parameter estimates obtained from two subsamples of the complete data set are very close. (Collier-IVI)

REGIONAL FREQUENCY ANALYSIS OF MULTIYEAR DROUGHTS USING WATER-SHED AND CLIMATIC INFORMATION, Montgomery (James M.), Inc., Salt Lake City, UT.

E. G. Paulson, Jr., J. Sadeghipour, and J. A.

Journal of Hydrology, Vol. 77, p 57-76, 1985. 1 Fig. 4 Tab, 31 Ref. NSF grant 77-11137 and University of California Water Resources Center grant W-615.

Descriptors: *Frequency analysis, *Droughts, *Cilmatology, *Statistical analysis, *Central Valley, *California, Meteorological data, Multiple regression analysis, Regression analysis, Streamregression analy-flow, Data interp

A regional frequency analysis of hydrologic multiplear droughts was performed using multiple linear regression to estimate characteristics of drought severity, magnitude and duration from indices of watershed geomorphology, and climate. Thirteen characteristics of drought severity, magnitude and duration were used as dependent variables; eleven indices of watershed geomorphology and meteorology were used as independent variables. Reasonable estimation accuracy was obtained utilizing Central Valley of California, U.S.A. streamflow data (mean standard errors between 14% and 41%). The proposed regression relations are primarily statistical models, and are not necessarily reliable indicators of cause-and-effect physical relationships. (Author's abstract) W86-00025

STATISTICAL CHOICE OF EXTREMAL MODELS FOR COMPLETE AND CENSORED

MODELS FOR COMPLETE AND CENSORIES
DATA,
Agricultural Univ., Wageningen (Netherlands).
Dept. of Mathematics.
M. A. J. Van Montfort, and M. I. Gomes.
Journal of Hydrology, Vol. 77, p 77-87, 1985. 3
Fig. 2 Tab, 10 Ref, 1 Append.

Descriptors: *Statistical analysis, *Mathematical studies, *Extremal models, *Censored data, Data interpretation, Hydrologic data, Model studies, Probability distribution.

Probability distribution.

Often one of the three well-known limiting distributions of univariate extremes, e.g. maxima of riverflow or precipitation, is successfully fitted to the data, and the estimated values corresponding to given return periods calculated. Within the framework of the general extreme-value distribution (GEV, with shape parameter Theta), which combines the Frechet (Theta < 0), Gumben (Theta = 0) and Weibull types (Theta > 0), the power functions of some statistics for rejecting the Gumbel distribution (Theta = 0) were compared. Often in checking the suitability of a distribution, a goodness of fit test is used involving the whole range of the distribution while the valid interest is one tail only. The interest in whether Theta deviates from zero arises when one is concerned with the value of a variate corresponding to a return period nearly equal to the length of the sample. The conditions for adequate behavior in the right-hand tail are not always the same as for the left-hand tail, and lack of fit in the left-hand tail should not influence inferences concerning the right-hand tail. It is necessary to consider the loss in power of tests for rejecting Theta = 0 in left-hand cancerd samples, where the observations with a rank lower than a specified value are missing. (Collier-IVI)

DISCRETE-TIME LINEAR CASCADE UNDER TIME AVERAGING,

National Hydrology Research Inst., Ottawa (On-

tario; V. Klemes, I. Klemes, and J. E. Glynn.
Journal of Hydrology, Vol. 77, p 107-123, 1985. 5
Fig, 13 Ref, 1 Append.

Descriptors: *Streamflow, *Model studies, *Linear cascades, *River basins, Stochastic process, Basin storage, Hydrologic models.

A cascade of linear reservoirs defined in discrete time has been suggested as a lumped conceptual model for a river basin for the case when the streamflow (basin output) at a control point is represented by an autoregressive time series in which the (uncorrelated and identically distributed) random component represents the time series of net basin input, i.e. roughly speaking, of precipi-tation minus evapotranspiration. An attempt has been made to find out whether the relationship been made to find out whether the relationship between the total gravity storage of a basin and its runoff, whose empirical determination is within the reach of hydrologic analysis, can be used to test the assumption of linearity of a discrete-time sto-chastic hydrologic model. A theoretical investiga-tion of the relationship between the total storage in a discrete-time linear cascade and the output at time t, and between averages of these two varia-bles over T consecutive times, is examined. (Baker-IVI) IVI) W86-00028

COMPARISON OF TWO DAILY STREAM-FLOW SIMULATION MODELS OF AN ALPINE WATERSHED, Colorado Univ. at Boulder. Dept. of Civil, Envi-ronmental, and Architectural Engineering. For primary bibliographic entry see Field 2E. W86-00033

DETERMINATION OF RESISTANCE PARAMETERS OF PLUVIO-NIVO-GLACIAL ALPINE SYSTEMS BY MATHEMATICAL MODELING

Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology. For primary bibliographic entry see Field 2E. W86-00034

MULTIPLE NONLINEAR STATISTICAL MODELS FOR RUNOFF SIMULATION AND

PREDICTION, Alcoa of Australia Ltd., Applecross. For primary bibliographic entry see Field 2E. W86-00035

EFFECTS OF INCORRECTLY REMOVED PERIODICITY IN PARAMETERS ON STOCHASTIC DEPENDENCE,
George Washington Univ., Washington, DC. International Water Resources Inst.
V. Yevjevich, and J. T. B. Obeysekera.
Water Resources Research, Vol. 21, No. 5, p 685-690, May, 1985. 6 Fig. 2 Tab, 7 Ref. NSF grant CEE-7916817 and CEE 84-05289/85-41631.

Descriptors: *Hydrologic time series, *Stochastic hydrology, *Time series analysis, Mathematical studies, Seasonal variation, Model studies, Har-

Most hydrologic time series are periodic-stochastic processes in which the stochastic component is mixed with periodic parameters. Modeling of seasonal hydrologic time series often requires the identification of periodic functions of its basic parameters such as the mean, standard deviation, and autocorrelation coefficients. The consequences of incorrect estimation of harmonics on dependence models of the stochastic component are investigated. For each underestimated harmonic in the periodic mean the stochastic nonstationary dependence models will have four additional terms, with four models will have four additional terms, with four coefficients to be estimated instead of only two in the harmonic. For each overestimated harmonic in the mean two additional coefficients must be esti-

Group 2A-General

mated, with a slight effect on estimated coefficients of dependence models and a practically negligible effect on model identification. If one has to select between underestimation or overestimation, the between underestimation or overestimation, the penalty is smaller for the case of overestimation of harmonics in the mean. The identification of the dependence model of the stochastic component is not significantly affected either by underestimation or overestimation. A neglect of periodicity in autocorrelation coefficients leads to inferences of incorrect stationary stochastic dependence models, while in reality they are nonstationary. (Baker-IVI) W86-00075

SYNTHESIS OF RADAR RAINFALL DATA, National Weather Service, Silver Spring, MD. Hydrologic Research Lab. W. F. Krajewski, and K. P. Georgakakos. Water Resources Research, Vol. 21, No. 5, p 764-768, May 1985. 1 Fig. 2 Tab, 14 Ref.

Descriptors: *Rainfall, *Radar, Rainfall-runoff re-lationships, Model studies, Hydrologic models, Simulation, Rain gages, Mathematical studies.

Procedures are being developed to merge radar and rain gage observations, to obtain the best estimate of the rainfall field, taking advantage of the spatial detail that the radar gives and of the high point accuracy of the gages. Reliable synthesis of radar-rainfall fields can be useful for validation as an alternative to field experiments. A method of generating synthetic radar-rainfall data is described. The data are generated by imposing random noise on a given, high-quality radar-rainfall field. Certain conditions are imposed on the scribed. The data are generated by imposing random noise on a given, high-quality radar-rain-fall field. Certain conditions are imposed on the resultant rainfall field so that the noise parameters are prespecified. In that way nonstationary nonergodic fields can be simulated. Since the original and the observation (original and noise) fields are known, the method can be used in the validation procedures of various hydrologic models (radar and rain gage data merging, mean areal precipitation estimation, rainfall-runoff). The example given shows that the accuracy of the preservation of the required statistics is very good, especially for realistic values of the variance measure, even for a relatively small number of realizations. The method proposed is flexible in that one can generate fields with a wide range of second order statistics from one high quality radar field. When the technique is used to investigate radar and rain gage data merging, a procedure is required to synthesize the gage data. (Baker-IVI)

ATTEMPT TO IMPLEMENT SWMM IN TUNI-SIA, Lund Univ. (Sweden).

For primary bibliographic entry see Field 6A. W86-00087

DATA MANAGEMENT FOR CONTINUOUS HYDROLOGIC SIMULATION, North Carolina Univ. at Charlotte. Dept. of Urban

and Environmental Engineering. J. S. Wu.

In: Proceedings of Stormwater and Water Quality and Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 161-176, 11 Fig. 6 Tab, 4 Ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall, *Runoff, *Agricultural watersheds, *Hydrologic models, *Model studies, *Regression analysis, *Watershed management, *Agricultural runoff, Evapotranspiration, Models, Watersheds, Groundwater recharge, Soil water, Simulation analysis.

The U.S. EPA's Agricultural Runoff Model (ARM) was applied to the continuous hydrologic simulation of one of the agricultural watersheds of the Chowan River Basin in North Carolina. Regression analysis was employed to generate missing rainfall-runoff data required for calibration of the ARM model. Monthly rainfall, evapotranspiration and runoff data served as model input data and output data consisted of monthly rainfall, runoff, evapotranspiration, soil moisture changes, and groundwater recharge. Model simulations agreed

well with per storm comparisons and recorded hydrographs and demonstrated the successful calibration for the Cutawhiskie site of the watershed. With a good data-base for calibration and verification, the continuous hydrological simulation model can be a useful tool for evaluating the effectiveness of watershed management practices over an extended period of time. W86-00093

SNOWMELT INDUCED URBAN RUNOFF IN

NORTHERN SWEDEN, McMaster Univ., Hamilton (Ontario). For primary bibliographic entry see Field 2C. W86-00097

STORM SEWER OPTIMUM DESIGN, For primary bibliographic entry see Field 8B. W86-00100

ATCHAFALAYA RIVER DELTA; REPORT 8: NUMERICAL MODELING OF HURRICANE-INDUCED STORM SURGE,
Coastal Engineering Research Center, Vicksburg,

B. A. Ehersole.

Technical Report HL-82-15, January 1985. Report 8 of a Series. 94 p, 61 Fig, 6 Tab, 21 Ref.

Descriptors: *Mathemetical models, *Simulation analysis, *Hydrodynamics, *Hurricanes, *Tidal hydraulics, Models, Model studies, Numerical analysis, Mathematical studies, Bays, Tides, Storm surges, Storm tides, Hydraulic models.

The U.S. Army Engineer Waterways Experiment Station Implicit Flooding Model (WIFM) was applied to the Atchafalaya River Delta Project. This numerical model was used to simulate the hydrodynamics within the bay resulting from astronomical and/or meteorological forcing. The WIFM model solves finite difference approximations of the governing equations on a grid mesh of fixed spatial extent for a finite number of constant time increments, utilizing an alternating direction improvements. spatial extent for a finite number of constant time increments, utilizing an alternating-direction, implicit solution scheme. The accuracy of the model was verified using a comparison of observed and simulated water elevations. Comparisons showed that the model can accurately simulate the response of the system to the astronomical tide and hurricanes. In the case of tides alone, errors were very small. However, in the storm surge applications, errors were larger. Using the verified model, a set of hypothetical storms was simulated. Dynamical characteristics of these storms reflect hurricanes that have occurred in this area in the past Hydrodynamics from these storms will be used in Hydrodynamics from these storms will be used in other tasks to investigate the response of the Atchafalaya River delta growth to extreme meteorological events. W86-00164

HYDROLOGICAL YEARBOOK: 1980.

Reeve (Douglas) and Associates, Toronto (Ontar-

Publications of the Water Research Institute, No. 53, 1983. 174 p, 2 Maps, 7 Append.

Descriptors: "Watersheds, "Hydrologic data col-lections, "Precipitation, "Runoff, "Floods, Finland, Groundwater, Rivers, Water level, Ice, Snow cover, Water temperature, Temperature, Hydro-graphs, Lakes, Frost, Water storage.

Hydrological statistics for Finland are reported. At the beginning of 1980 water storage was average for the season. Toward the end of the year storage was exceptionally low in the north and plentiful in the south. A 100-yr flood for autumn occured in the Aurajoki in late November; other rivers flooded during this time. At the end of the year record snow cover, up to 150 mm of water in some places, was on the ground. Tables and hydrographs include data on water levels and stages, discharge, maps of hydrological basins, runoff, areal precipitation and water equivalent of snow cover, evaporation, surface temperature of open waters, dates of freeze-up and ice breakup, ice cover thickness, ground frost, and groundwater. Hydrological statistics for Finland are reported. At

W86-00182

HYDROLOGICAL SIMULATION PROGRAM-FORTRAN (HSPF): USERS MANUAL FOR RE-LEASE 8.0,

University of the Pacific, Stockton, CA. R. C. Johanson, J. C. Imhoff, J. L. Kittle, and A.

S. Donigan. S. C. Inner, S. E. Rick, and P. S. Donigan. EPA-600/3-84-006, June 1984. Environmental Protection Agency, Athens, GA. 767 p. 138 p. 49 Ref, 5 Append. Contract/Grant No. 68-01-6207.

Descriptors: *Hydrologic models, *Model studies, *Computer programs, Streams, Lakes, Hydrological Simulation Program-FORTRAN, Water quality, Water supply, Rainfall-runoff relationships, Data processing, Fortran.

The Hydrological Simulation Program-FOR-TRAN (HSPF) is a set of computer codes that can simulate the hydrologic, and associated water quality, processes on pervious and impervious land surfaces and in streams and well mixed impoundments. The manual discusses the modular structure of the system, the principles of structured programming technology and the use of these principles in the construction of the HSPF software. In addition, to a nictorial representation of how each ples in the construction of the HSPF software. In addition to a pictorial representation of how each of the 500 subprograms fits into the system, the manual presents a detailed discussion of the algorithms used to simulate various water quality and quantity processes. Data useful to those who need to install, maintain, or alter the system or who wish to examine its structure in greater detail also are presented. (Author) W86-00199

2B. Precipitation

STATISTICAL ANALYSIS OF PRECIPITA-TION FREQUENCY IN THE CONTERMINOUS UNITED STATES, INCLUDING COMPARI-SONS WITH PRECIPITATION TOTALS, SONS WITH PRECIPITATION TOTALS, Midwest Recearch Inst., Kansas City, MO. P. J. Englehart, and A. V. Douglas. Journal of Climate and Applied Meteorology, Vol. 24, No. 4, p. 350-362, April, 1985. 7 Fig. 5 Tab, 32 Ref. NSF grant ATM-8219370.

Descriptors: *Statistical analysis, *Total precipita-tion, *Precipitation frequency, *Weather data col-lections, Data interpretation, Spatial distribution,

An alternative measure of time-aggregated precipitation for use in short-term climate studies was developed; this measure, precipitation frequency, is defined as the number of days per month or season with total amounts > or = 2.54 mm (0.10 inch). Newly created data sets for the period 1951-80 were used as a basis for describing large-scale spatial and temporal features of precipitation frequency for the mainland United States. Comparisons between precipitation frequency and the conventional statistic, total precipitation, indicate that frequency is more normally distributed and more spatially coherent than total precipitation. Factor analysis and an orthogonal rotation to the varimax criterion identify synoptic-scale, spatially coherent regions of precipitation frequency. The regions are generally consistent with previously documented cyclone trajectories. (Author's abstract)

SOIL MOISTURE CONTENT: STATISTICAL ESTIMATION OF ITS PROBABILITY DISTRI-

Kozponti Meteorologiai Intezet, Budapest (Hungary). For primary bibliographic entry see Field 2G. W86-00021

ANALYSIS OF THE EFFECTS OF OROGRA-PHY ON SURFACE RAINFALL BY A PARA-METERIZED NUMERICAL MODEL, Consiglio Nazionale delle Ricerche, Perugia (Italy). Ist. di Ricerca per la Protezione Idrogeolo-gica nell' Italia Centrale.

C. Corradini Journal of Hydrology, Vol. 77, p 19-30, 1985. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Orography, *Rainfall, *Model studies, *Geography, *Upper Tiber River basin, *Italy, Spatial distribution, Hydrologic models, Data interpretation, Orographic precipitation, Precipita-

A numerical model was formulated for estimating the spatial distribution of rainfall on the meso-local scale; the model considers widespread rainfall not influenced by convective processes. The observed rainfall on the soil surface unaffected by orographically produced contributions and meteorological parameters on the large scale are used as inputs to the model. The model is then used for computing the spatial distribution of rainfall incorporating the orographic effects in a parameterized form. The model was applied to four rainfall events over an area of the Upper Tiber River basin (central Italy); the results compare reasonably well with the observations in each event. The error in computing mean areal rainfall ranges in magnitude from 1% to 15%; for each event at least 75% of the pointestimates has an error of less than + or - 30%. (Author's abstract)

INTERCEPTION STORAGE CAPACITIES OF TROPICAL RAINFOREST CANOPY TREES, Boston Coll., Chestnut Hill, MA. Dept. of Geology and Geophysics. For primary bibliographic entry see Field 2I. W86-00037

ESTIMATION OF MISSING VALUES IN MONTHLY RAINFALL SERIES, Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences. E. Foufoula-Georgiou. In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 177-191, 3 Fig, 6 Tab, 19 Ref.

Descriptors: *Statistical analysis, *Time series analysis, *Statistical models, *Model studies, *Mathematical studies, *Stochastic process, *Stochastic hydrology, *Model testing, Statistical methods, Theoretical analysis, Models, Mathemati-

Three methods for infilling missing values in hydrological time series are discussed. The first method utilizes regional-statistical data by the mean value method, the reciprocal distance method, the normal ratio method or the modified weighted average method. The second method uses a univariate stochastic (ARMA) model which describes the time correlation of the series. The third technique relies on a multivariate stochastic (ARMA) model which describes the time and space correlation of the series. An algorithm for the recursive estimation of the missing values by a parallel updating of the univariate or multivariate stochastic ARMA models is proposed and demonstrated. All of the infilling methods were applied to a case study using 55 yr of monthly rainfall data from four south Florida stations. Results showed that all the the traditional estimation techniques give unbiased (overall and monthly) means and correlation coefficients at the 5% significance level for as high as 20% missing values. If an ARMA model is to be used in an incomplete series to construct forecasts, then the estimation of missing values and parameters of the model by the proposed recursive algorithm is recommended.

AREAL INTENSITY-DURATION-FREQUENCY CURVES: A POSSIBLE WAY OF IMPROVING THE RAINFALL INPUT, Lund Univ. (Sweden). Dept. of Water Resources

Engineering.

J. Niemczynowicz

In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 192-201, 6

Fig. 1 Tab. 17 Ref.

Descriptors: *Areal precipitation, *Rainfall intensity, *Graphical methods, *Precipitation intensity, *Depth-area-duration analysis, *Frequency analysis, *Regional analysis, *Mathematical studies, Precipitation, Storms, Rainfall, Runoff, Rain gauges, Urban hydrology, Data interpretation

Urban hydrology, Data interpretation.

Point and areal intensity-duration-frequency (i-d-f) curves for the city of Lund, Sweden were generated using data from a 25 sq km area raingauge network with 12 gauges installed in 1978. The gauges were of the automatic tipping-bucket type and were governed by the same clock to achieve absolute time synchronization. Since the main goal of this study was to compare the point rainfall statistics with the areal rainfall statistics for short term rainfalls, all events with low intensity were taken out of the data base. To extrapolate rainfall data from point to areal values, specific areas were associated to all gauges. Analysis of results showed that areal i-d-f relationships gave different rainfall values then point i-d-f relationships. Areal rainfall intensity values were lower for all durations and return periods. If point i-d-f curves are used for deriving design storms, the error in average rainfall intensity and rainfall volume will be introduced for simulation of runoff from real catchments. The magnitude of error depends on duration, return period, and catchment size. The most significant differences between point and areal rainfall values can be found for short durations and long return periods. The areal i-d-f curves gave more realistic design storms than those derived from point i-d-f curves.

W86-00095 curves. W86-00095

OUTLINE OF SEVERE LOCAL STORMS WITH THE MORPHOLOGY OF ASSOCIATED RADAR ECHOES, National Weather Service Training Center, Kansas

National Weather Service Training Center, Kansas City, MO.
R. Grebe.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-114454.
National Oceanic and Atmospheric Administration, Rockville, MD. June 1982. NOAA Technical Memorandum NWS TC 1. 80 p. 56 Fig, 64 Ref, 9 Append.

Descriptors: *Radar, *Storms, *Thunderstorms, *Weather forecasting, *Storm warnings, Storms, Velocity derived fields, Doppler radar.

This outline focuses on the interpretation of conventional radar data for the identification of severe local storms. The technique of improving warnings is dependent upon the ability to identify the potential before the event occurs. The primary tools presently available include trained spotters, and satellite and radar observations. Most of the radar research work in severa local torms accomplished. presently available include trained spotters, and satellite and radar observations. Most of the radar research work in severe local storms accomplished in the 1970's was done with Doppler radar. Doppler is conventional radar plus 'more'. The 'more', velocity derived fields, has increased our understanding of storm structure and the morphology of precipitation related echoes. It will be to the advantage of the operational community using conventional radar to apply the technology of Doppler in a practical way. Documented radar signatures associated with severe local storms dating back to the 1950's have been included. Some of them are in apparent conflict with contemporary storm models. The rationale for including them is (1) these signatures can still be operationally useful as alerting features and (2) today's storm models are likely to change as our understanding of the physical processes that produces them increases. As such, this outline is not intended to conflict with National or Regional Weather Service policy regarding the use of radar signatures in issuing severe thunderstorm or tornado warnings. The test of a radar signature leading to the identification of a severe local storm occurs in the field under the stress of making day-to-day warning decisions. No signature or combination of signatures guarantees the existence of a severe storm any more than a numerical model will produce a perfect weather forecast. In both cases, a probability is assigned to the occurrence of the event and a decision is based on that probability.

W86-00146

MARINE WEATHER OF THE INLAND WATERS OF WESTERN WASHINGTON, National Oceanic and Atmospheric Admin tion, Seattle, WA. Pacific Marine Environm

J. E. Overland, and B. A. Walter. NOAA Technical Memorandum ERL PMEL-44, January 1983. 62 p, 30 Fig, 7 Tab, 42 Ref.

Descriptors: *Precipitation, *Meteorology, *Climatic data, *Marine climates, *Weather patterns, Washington, Puget Sound, Pacific Ocean, Wind, Olympic Mountains, Topography, Temperature, Hydrology, Hood Canal bridge.

Hydrology, Hood Canal bridge.

The mid-latitude, west coast marine climate of western Washington is typified in summer by high sea-level pressure as part of the North Pacific weather pattern and in winter by a sequence of storms which originate to the west. Mean and actreme temperatures are moderated by the proximity of the Pacific Ocean and Puget Sound, resulting in a mean temperature of 4 degrees C in January and 17 degrees C in August at Seattle. Local variations in precipitation and wind are influenced by both large-scale weather patterns and the region's topography. Fifty percent of the annual precipitation for most of the inland region falls in the four months from November through February, and less than five percent falls in July and August; the driest region is to the northeast of the Olympic Mountains. Over the inland waters, the winds flow from high to low sea-level pressure in the direction of the local channels. Recent studies by the University of Washington and the Pacific Marine Environmental Laboratory on the Puget Sound convergence zone, sea and valley breeze, precipitation patterns and local wind patterns are summarized. The storm which resulted in destruction of the Hood Canal Bridge has shown that the presence of the Olympic Mountains can induce a regional low-pressure system in their lee which can result in strong surface winds over the inland regional low-pressure system in their lee which can result in strong surface winds over the inland waters. (Author)

SCPP DATA COLLECTION AND ANALYSIS FOR THE PERIOD 1 SEPTEMBER 1981 THROUGH 31 AUGUST 1982,

Atmospherics, Inc., Fresno, CA.. M. Solak, T. Henderson, R. Allen, S. Barnes, and M. Henderson

M. Henderson. Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116707. Interim Progress Report Number Four, August 27, 1982. 182 p. 62 Fig. 13 Tab, Append. Contract/Grant No. 9-07-85-V0020.

Descriptors: *Precipitation, *Network design, *Cloud physics, *Ice formation, *Weather modification, Sierra Nevada, Orographic precipitation, Data collections, Supercooling, Cooling, Data acquisition, Meteorological data collection, Data processing, Gages, Snow.

Data collection and analysis tasks performed for the Sierra Cooperative Pilot Project are described. The Sierra project is concerned with the physical processes of precipitation formation during the winter over a portion of the Sierra Range in California, artificial enhancement of winter precipitation, and weather resources management to improve California's water resources in this mountain range. Tasks performed were installation, operation, and maintenance of, and data collection and analysis from, a network of precipitation gages as well as ground-based instrumentation for detection of supercooled liquid water.

W86-00216

GROUND-BASE SNOW AND ICE CRYSTAL OBSERVATION SYSTEM USED IN SIERRA NEVADA WINTER OROGRAPHIC STORMS,

Atmospherics, Inc., Fresno, CA.
M. Henderson, M. Henderson, S. Pinion, E.
Pinion, and M. Solak.
Technical Report AISCP-841, April 1984. 34 p, 3

Field 2—WATER CYCLE

Group 2B—Precipitation

Fig. 5 Tab, 38 Photos, 9 Ref. Contract/Grant No. 0-07-85-V0020.

Descriptors: *Precipitation, *Weather modifica-tion, *Snow, *Ice, Orographic precipitation, Pho-tography, Cloud physics, Cloud seeding, Artificial precipitation, Sierra Nevada, California, Sierra Co-operative Pilot Project, Sampling, Data acquisition. Crystals.

This report describes the use of a ground based photographic snow and ice crystal observation system during two winter seasons at a fixed sampling site near the summit of the central Sierra Nevada range of California. This research effort was performed as part of the Bureau of Reclamation's Sierra Cooperative Pilot Project (SCCP), an investigation of the technical feasibility and potential economic benefit of cloud seeding in the Sierra Nevada to supplement the region's water supply. Two specific photographic systems and their operational use are detailed. Data reduction and analysis techniques are also described. Conclusions are presented relating to three key topic areas. Those sis techniques are also described. Conclusions are presented relating to three key topic areas. Those are (1) the suitability of the sampling equipment, sampling strategies and data acquisition/reduction techniques used in the SCPP application, (2) clues to seedability in Sierra storms and (3) the utility of ground-based microphysics measurements in evaluating seeding experiments. (Author) W86-00222

APPLICATION OF PROBABLE MAXIMUM PRECIPITATION ESTIMATES: UNITED STATES EAST OF THE 105TH MERIDIAN,

National Weather Service, Silver Spring, MD.
Office of Hydrology.
E. M. Hansen, L. C. Schreiner, and J. F. Miller.
Available from the Technical Information Service,
Springfield, VA 22161 as PB83-118166. NOAA
Hydrometeorological Report No. 52, August 1982.
168 p, 57 Fig, 31 Tab, 22 Ref, 1 Append.

Descriptors: *Precipitation, *Rainfall, Rainstorms, Maximum probable precipitation, Meteorology, Storms, Isohyets, Temporal distribution, Spatial distribution, Distribution, Estimating.

A stepwise approach to adapting the temporal and spatial distribution of probable maximum precipitation estimates to a specific drainage is given. An elliptical isohyetal pattern with a ratio of major to minor axes of 2.5 to 1 is recommended. Procedures are publicated for obtaining appropriate includes minor axes of 2.5 to 1 is recommended. Procedures are outlined for obtaining appropriate isohyet values and for determining probable maximum precipitation values for durations less than 6 hours. The shape and orientation of isohyetal patterns for major rainfalls of record are included. An appendix lists storm duration, storm area, and 24-hour rainfall for 253 major storms from 1878 to 1972. W86-00229

BOULDER UPSLOPE CLOUD OBSERVATION

Descriptors: *Precipitation, *Cloud physics, *Remote sensing, *Meteorologic data collection, Upslope precipitation, Ice, Snow, Fog, Radar, Radiometers, Lidar, Aircraft, Ceilometer, Boulder Upslope Cloud Observation Experiment, Data collections, Crystals, Microwaves, Weather.

The Boulder Upslope Cloud Observation Experiment was designed to learn more about the role of ice crystals in the formation of clouds and precipitation under upslope conditions; to calibrate the remote sensing systems against reliable in situ devices in a steady, homogeneous cloud environment; and to evaluate the systems' applicability for observing the role of ice crystals and cloud microphysics in the evolution of upslope precipitation. Eleven principal weather events in the spring of 1982 are described. In situ measurements were made by aircraft, tower particle measurements, surface chemistry sampling, all-sky camera, and

rotating beam ceilometer. Ground-based remote sensing measurements were made by radiometer, radar, and lidar. W86-00261

POSTSTORM RECONNAISSANCE OF TROPI-CAL STORM CHRIS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. T. H. Flor.

Miscellaneous Paper HL-83-5, July 1983. Final Report. 18 p, 9 Fig, 6 Append.

Descriptors: *Precipitation, *Storms, Tropical Storm Chris, *Flood damage, Tidal floods, Shores, Seashores, Damage, Rainstorms.

Tropical Storm Chris made landfall in Louisiana, 7 miles east of Sabine Pass, Texas, at 0600 CDT on September 11, 1982. Highest sustained winds were September 11, 1982. Highest sustained winus weice 55 knots. Lowest pressure was estimated to be 994 mbs. Highest tides were between 5 and 6 feet just east of the center. Rainfall was 5 to 10 inches in east of the center. Rannah was 5 to 1 inches in Louisiana, with a few local amounts greater than 10 inches. The highest storm-generated surge, 8.5-9 ft, occurred at Peveto Beach, 8 miles east of the point of landfall. Flooding west and east of the point of landfall was 2.8 ft above predicted tide level 17 miles to the west and 2.5 ft above predictlevel 17 miles to the west and 2.5 it above predicted tide 19 miles to the east. No casualties were reported. Damage estimates were < \$1 million in Louisiana. Power lines, trees, and boats were also damaged, as well as a restaurant in Texas. W86-00279

CLOUD PHYSICS STUDIES IN THE SCPP: IN-TERIM PROGRESS REPORT, 1983-84.
Wyoming Univ., Laramie. Dept. of Atmospheric Science.

For primary bibliographic entry see Field 3B. W86-00305 ence.

STRUCTURE OF COLD FRONTS OVER CALI-

FORNIA, Wyoming Univ., Laramie. Dept. of Atmospheric Science. For primary bibliographic entry see Field 3B. W86-00306

RESPONSES TO SEEDING CLOUDS WITH DRY ICE IN THE SCPP-1 EXPERIMENT, Wyoming Univ., Laramie. Dept. of Atmospheric Science.

For primary bibliographic entry see Field 3B. W86-00307

2C. Snow, Ice, and Frost

RUNOFF FROM GLACIERIZED MOUNTAINS: A MODEL FOR ANNUAL VARIATION AND ITS FORECASTING, Stirling Univ. (Scotland). Dept. of Environmental

For primary bibliographic entry see Field 2E. W86-00077

SNOWMELT INDUCED URBAN RUNOFF IN NORTHERN SWEDEN, McMaster Univ., Hamilton (Ontario).

L. Bengtsson. In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 215-236, 6 Fig, 11 Tab, 10 Ref.

Descriptors: *Snowmelt, *Runoff, *Snowpack, *Design criteria, *Melting, *Urban runoff, *Surface runoff, *Overland flow, Annual runoff, Soil water, Infiltration rate, Infiltration capacity, Snow cover, Thaw, Urban hydrology.

Snowmelt and runoff data collected at different sites in the Lule region of Sweden over a 7 yr period are summarized and analyzed. The maximum observed melf flux to the base of a snowpack during 1 h is 4.1 mm/h. The maximum observed

daily melt is 40 mm, but the daily melt of a 2-yr daily melt is 40 mm, but the daily melt of a 2-yr return period is only 20 mm. The runoff from small study plots, at least in practical considerations, is found to be distributed over about 12 h. The maximum observed runoff from these study plots of hard packed gravel or grass surfaces is about 2 mm/h. In the late phase of a snowmelt period, the daily runoff closely corresponds to the daily melt. However, the very maximum runoff values are observed during or some days after the snowmelt period. Overland flow or flow just below the ground surface takes place. Design melt rates for open areas in Sweden are 20 mm/12 h for a melt rate of 1-yr return period and 3 mm/h for a shorter open areas in Sweden are 20 mm/12 h for a melt rate of 1-yr return period and 3 mm/h for a shorter interval. For urban areas a value of at least 30 mm/12 h is suggested. For forested areas the value should be 10 mm/12 h. Rain during the snowmelt should be added to the melt. If there is much rain in the autumn and soil temperatures are low before snow cover is formed, overland flow should take place from all surfaces in the late snowmelt period. If the soil is packed hard, the runoff may correspond to the melt rate. W86-00097

2D. Evaporation and Transpiration

COMPARING THE PERFORMANCE OF ROOT-WATER-UPTAKE MODELS, Katholieke Univ. Leuven (Belgium). Lab. of Soil

M. Alaerts, M. Badji, and J. Feyen. Soil Science, Vol. 139, No. 4, p 289-296, April, 1985. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Root-water-uptake models, *Soil water, *Model studies, Sink terms, Root-water-extraction terms, Hydrologic budget, Nitrogen budget, Transpiration, Nutrient removal, Nutrient uptake.

pudget, Transpiration, Nutrient removal, Nutrient uptake.

To model the water balance of a cropped soil, a root-water-extraction term, the so-called sink term, is added to the general flow equation describing the water flow in the unsaturated zone. To compare different proposed sink-terms, they should be used as variable components of the same field water budget model. Four root-water-extraction terms selected from the literature were adapted and inserted into the field water budget model SWATRE. The models were run with simplified initial and boundary conditions and showed agreement with regard to the cumulative water loss over a period of 20 d, if the input data and parameter values were adjusted. They resulted, however, in significantly different daily water-extraction-depth patterns. The most sophisticated model appears to contain a number of redundant terms, and the least complicated model could not be applied when a water table was present. The water-extraction-depth pattern is of special importance if the water budget model is used as a component of, for example, a nitrogen budget model. The simulated nutrient uptake will depend greatly on the moisture extraction pattern. Choice of sink term might be difficult under real field conditions and with validation data available. All sink terms require the choice of parameters adapted to the particular soil-plant combination. This almost automatically implies some data-fitting, because independent data for similar conditions are rarely available, and the knowledge for extrapolating from different conditions is lacking. Too little seems to be known about plant transpiration and water extraction patterns to result in a general extraction term which is simple and economical to use and satisfying in concept and results. (Collier-IVI)

2E. Streamflow and Runoff

NUMERICAL MODELLING OF SUBCRITICAL OPEN CHANNEL FLOW USING THE K-EPSI-LON TURBULENCE MODEL AND THE PENALTY FUNCTION FINITE ELEMENT TECHNIQUE,

Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Civil Engineering. A. N. Puri, and C. Y. Kuo.

Applied Mathematical Modelling, Vol. 9, No. 2, p 82-88, April, 1985. 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Mathematical models, *Open-channel flow, *Turbulent flow, *Penalty function, *Finite element method, Curved channels, Flow, Channel flow, Momentum dispersion models, Turbulence closure models.

A numerical model has been developed that employs the penalty function finite element technique to solve the vertically averaged hydrodynamic and turbulence model equations for a water body using isoparametric elements. Solving of the full elliptic forms of the equations allowed recirculating flows to be calculated. Alternative momentum dispersion and turbulence closure models were evaluated by comparing model predictions with experimental data for strongly curved subcritical open channel flow. The results of these simulations indicate that the depth-averaged two-equation K-epsilon turbulence model yields excellent agreement with experimental observations. Neither the streamline curvature modification of the depth-averaged K-epsilon model, nor the momentum dispersion models based on the assumption of helicoidal flow in a curved channel, yield significant improvement in the present model predictions. Overall model predictions were found to be as good as those of a more complex and restricted three-dimensional model. (Author's abstract)

SPATIALLY VARYING RAINFALL AND FLOODRISK ANALYSIS, Massachusetts Inst. of Tech., Cambridge. R. L. Bras, D. R. Gaboury, D. S. Grossman, and G. J. Vicens.

Journal of Hydraulic Engineering, Vol. 111, No. 5, p 754-773, May, 1985. 10 Fig. 5 Tab, 7 Ref.

Descriptors: *Rainfall distribution, *Floodrisk analysis, *Flood forecasting, *Cumberland River Basin, *Kentucky, *Tennessee, *Simulation analysis, Model studies, Rainfall-runoff relationships,

A mathematical simulation model of the spatial and temporal rainfall process was developed and used to input to distributed rainfall-runoff models in order to obtain streamflow series at multiple locations in large river basins. Frequency analysis under different basin development and control alternatives can then be performed. A location in the Cumberland River Basin (Kentucky and Tennessee) was studied. The basin is 46,397 sq km (17,914 sq mile) and thus exhibits large rainfall variability in space. The rainfall model was calibrated with 28 yr of hourly and daily rainfall data in 274 stations in and around the basin. By using generated rainfall as input to a previously calibrated distributed rainfall-runoff model, discharge frequency curves were obtained at 14 locations. The curves corresponded to both the system with eight operational flood control reservoirs and the natural system without regulation. (Author's abstract)

METHOD OF PREDICTING DAILY PEAK FLOWS IN THE HIGH-FLOW SEASON, Saskatchewan Univ., Saskatoon. Dept. of Geogra-

phy. P. R. Waylen. Journal of Hydrology, Vol. 77, p 89-105, 1985. 7 Fig. 1 Tab, 21 Ref.

Descriptors: *Peak flows, *Flood forecasting, *Seasonal distribution, *British Columbia, Streamflow forecasting, Forecasting, Orographic precipitation, Data interpretation, Statistical analysis,

Partial duration series provide a method of obtaining the distributions of both high-flow variables and annual floods. The seasonal nature of streamflow requires assumptions of nonhomogeneity of the timing of events. The modeling of timing is based upon the temporal behavior of high flows generated by distinct processes. The approach is physically meaningful and able to accommodate several generating processes. In southern British

Columbia, Canada, snowmelt and rainfall produce high flows. Individually the distribution of each set of annual maxima produced by the respective processes are successfully represented by a double exponential distribution which, compounded, provide a good fit in locations of mixed generating processes. In all cases introduction of the time nonhomogeneity term to the double exponential for periods of less than 1 yr. provides a good fit to the observed distribution of daily peak flows throughout the high-flow season. (Author's abstract)

DISCRETE-TIME LINEAR CASCADE UNDER TIME AVERAGING,

National Hydrology Research Inst., Ottawa (Ontario). For primary bibliographic entry see Field 2A. W86-00028

GOULD'S PROBABILITY MATRIX METHOD; 1. THE STARTING MONTH PROBLEM, Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering. R. Srikanthan, and T. A. McMahon. Journal of Hydrology, Vol. 77, p 125-133, 1985. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Streamflow, *Gould's probability matrix, Australia, Rivers, Reservoirs, Probability distribution.

A major problem of water-supply authorities is to determine the relationship of the capacity of a large reservoir with its inflows and potential releases. Annual and/or monthly streamflow data for nine Australian rivers covering a range of characteristics are used to aid in solving this problem. Mean monthly flows (expressed as percentages of annual flow) and the annual coefficients of variation and lag-1 autocorrelation coefficients for different starting months are shown. Results based on synthetic data indicate shown. gon and lag-I autocorrelation coefficients of varia-ferent starting months are shown. Results based on synthetic data indicate that in Gould's probability matrix method the yearly routing of monthly flows should start in a month of low mean monthly flow. Results from historical data also indicated this, but are masked by the sample variability of the esti-mates. For analysis, the monthly data should be assembled into years defined by the water year which should begin and end normally during a time of low flow. (Baker-IVI)

GOULD'S PROBABILITY MATRIX METHOD; 2. THE ANNUAL AUTOCORRELATION PROB-

LEM, Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol. 77, p 135-139, 1985. 3
Fig. 1 Tab, 4 Ref.

Descriptors: *Gould's probability matrix, *Streamflow, *Autocorrelation, Reservoirs, Water supply, Water storage, Flow.

The effect of lag-1 annual autocorrelation on storage sizes obtained from Gould's probability matrix method is examined using long sequences of generated data. The range of applicability of Gould's method and the associated correction factors for annual autocorrelation are proposed. The correction factor to take into account the annual autocorrelation coefficient was found to depend mainly on the annual lag-1 autocorrelation coefficient, r, and storage size. Except for a few limited combinations of r, annual coefficients of variation (Cv), and draft, the correlation factor is larger than 1.5, implying Gould's transition probability matrix method is not a suitable procedure for rivers with significant annual autocorrelation coefficients. Gould's procedure may be used for small r (0.2) olog as the correction factor is not greater than 1.5. Correction factors are presented. (Baker-IVI)

VARIANCE OF THE T-YEAR EVENT IN THE LOG PEARSON TYPE-3 DISTRIBUTION.

Streamflow and Runoff—Group 2E

Asian Inst. of Tech., Bangkok (Thailand). H. N. Phien, and L.-C. Hsu. Journal of Hydrology, Vol. 77, p 141-158, 1985. 6 Tab. 11 Ref

Descriptors: *Floods, *Rainfall, *Distribution, *Log Pearson type-3 distribution, Mathematical equations, Variance, Computers.

Detailed schemes for computing the variance of Detailed schemes for computing the variance of the T-yr. event, the variances and covariances of the parameter estimates for the LP3 distribution were described along with the provision of analyti-cal formulae for all related computations. Var-iances and covariances are analytically derived in this study for the case where the parameters are estimated by the methods of direct and mixed moments. The examples given clearly show that the error committed in estimating the parameters of the LP3 distribution was very high, and the highest error seemed to take place in estimating the shape parameter. At present, an attempt is being shape parameter. At present, an attempt is being made to apply the presented computational schemes to many more data sets of annual floods and annual maximum rainfalls, whereby general annual maximum raintalis, whereby general conclusions may be drawn on the performance of the different methods for parameter estimation. To help the evaluation process, a set of computer programs in FORTRAN have been developed according to the schemes presented in this paper. (Baker-IVI) W86-00031

COMPARISON OF TWO DAILY STREAM-FLOW SIMULATION MODELS OF AN ALPINE WATERSHED, Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering. C. M. Brendecke, D. R. Laiho, and D. C. Holden. Journal of Hydrology, Vol. 77, p 171-186, 1985. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Alpine areas, *Streamflow, *Simula-tion, *Model studies, *Colorado, Computer models, Data interpretation, Hydrograph, Rainfall-runoff relationships, Hydrologic models.

A comparison of daily streamflow simulation by two different computer models has been completed for an alpine basin in central Colorado, U.S.A. The catchment is part of a 33-sq km area providing most of the City of Boulder's raw water supply. It is located between 2964 and 4103 m a.s.l. in elevation along the Continental Divide 24 km west of Boulder, Colorado. The Streamflow Synthesis and Reservoir Regulation model, which makes generous use of lumped-type parameters, was compared with the Precipitation Runoff Modeling System (PRMS) model, which makes greater use of individually defined parameters, by examining their respective ability to fit observed hydrograph volumes and shape. Both computer models were respective ability to fit observed hydrograph vol-umes and shape. Both computer models were found to simulate streamflow equally well. The PRMS model was found to be more suitable over-all because of its ability to handle small catchments and the generous use of individual physically-based parameters. (Author's abstract) W86-00033

DETERMINATION OF RESISTANCE PARAMETERS OF PLUVIO-NIVO-GLACIAL ALPINE SYSTEMS BY MATHEMATICAL MODELING

OF RUNOFF,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
A. A. Van De Griend, and E. Seyhan.
Journal of Hydrology, Vol. 77, p 187-207, 1985. 7
Fig. 1 Tab, 42 Ref.

Descriptors: *Alpine regions, *Mathematical models, *Runoff, *Hydrologic models, *Italy, Rainfall-runoff relationships, Glaciohydrology, Snowmeit, Geohydrology.

A nonlinear optimization technique has been applied to analyze complex hydrographs from an alpine catchment with pluvial, nival and glacial regime components, in order to determine bulk resistance parameters of the contributing systems. Both the fluvial system and the nivo-glacial system

Group 2E-Streamflow and Runoff

are represented by a linear system function. Application of the optimization model to monthly time series of daily runoff, revealed the time variability of the systems operation which reflects the seasonal variability of hydro(geo)logical and snow-hydrological conditions relevant for the creation of runoff. The model has been applied to a northern Italian Alpine catchment with a runoff record of 22 yr. (Author's abstract) W86-00034

MULTIPLE NONLINEAR STATISTICAL MODELS FOR RUNOFF SIMULATION AND PREDICTION,

Alcoa of Australia Ltd., Applecross. E. N. Tsykin.

Journal of Hydrology, Vol. 77, p 209-226, 1985. 1 Fig, 3 Tab, 9 Ref, 3 Append.

Descriptors: *Statistical models, *Runoff, *Prediction, Model studies, Rainfall-runoff relationships, Hydrologic models, Soil water.

Hydrologic models, Soil water.

The lack of accuracy of statistical rainfall-runoff models is often caused by lack of correspondence between the nonlinear structure of the process and the linear structure of the statistical equation. Multiple nonlinear equations with separate antecedent soil-moisture indices for each time period and with a combined intercept allow the modeling of rainfall-runoff relations with high accuracy. The coefficients of determination between actual and simulated runoff for the calibration periods are typically higher than 0.90 and often as high as 0.96. Extrapolation over periods 34 times longer than the calibration have provided accurate predictions, with corresponding R2-values of 0.85 and higher. Extrapolations using these models are accurate even when the calibration period is relatively short and its range is smaller than the range of the predicted values. (Collier-IVI)

ESTIMATES OF PEAK RUNOFF FROM HILLY TERRAIN WITH VARIED LITHOLO-

GT, International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
A. M. J. Meijerink.
Journal of Hydrology, Vol. 77, p 227-236, 1985. 6
Fig, 9 Ref.

Descriptors: *Peak runoff, *Runoff, *Topography, *Lithology, *Italy, *Spain, *India, *Tunisia, *Carinena, Slope-area method, Geomorphology, Streamflow, Rainfall distribution, Soil conserva-

Rainfall data for shorter durations may not be adequate in areas with strong relief; in such cases the common engineering formulas for the estimations of the peak discharges are difficult to apply. It may also not be feasible to use empirical formulas based on regression analyses from nearby regions. For estimating the peak flows one may have to resort to the use of the slope-area method and survey channel sections. Estimates of peak runoff were made using the slope-area method in hilly regions with poor adjustment of channel morphology to high flows. Geomorphological maps were made for each of four areas studied. The main units coincided with the geology and within each of the main units, channel reaches were surveyed. Small rivers were investigated in four areas: A basilicata area in southern Italy; the area around Carinena in central Spain; the area around Bata Nala-Renuka, Himachal Pradesh in north India; and the area around Kasserine in southwestern Tunisia. Despite the inaccurate nature of the methods, a meaningful interpretation of the results could be made. In the two Mediterranean areas the effects of the highly differing morpholithological units on the peak runoff could be demonstrated, although estimates of few catchments have been used. The method is not sensitive enough to reflect the effects of less pronounced morphologic variations and supposed geographic variations in rainfall intensities; this is indicated by the results of the area in northern India. In the semi-arid area of Kasserine the lithology and geomorphology of the oteem to affect the indicated by the results of the area in northern India. In the semi-arid area of Kasserine the lithology and geomorphology did not seem to affect the peak flows with great return periods. The method

may contribute to improved methods in soil and water conservation, and estimates of the capacities of cross-drainage works. An idea of the internal variation of direct response within larger catch-ments can also be obtained. (Collier-IVI) W86-00036

CONDENSED DISAGGREGATION MODEL FOR INCORPORATING PARAMETER UN-CERTAINTY INTO MOUTHLY RESERVOIR SIMULATIONS, Cornell Univ., Ithaca, NY. Dept. of Environmen-

J. R. Stedinger, D. Pei, and T. A. Cohn. Water Resources Research, Vol. 21, No. 5, p 665-675, May, 1985. 7 Fig. 5 Tab, 74 Ref. NSF grant CME 8010889.

Descriptors: *Reservoirs, *Simulation, *Boise River, *Rappahannock River, Model studies, Pa-rameters, Distribution, Water supply, Water shortages, Reservoir failure.

A condensed version of the Valencia-Schaake disaggregation model was developed which describes the distribution of monthly streamflow sequences using a set of coupled univariate regression models rather than a multivariate time series formulation. The model is attractive because it has fewer pa-The model is attractive because it has fewer parameters but can still reproduce the means, variances, and period to period correlations of the individual flows while approximately preserving the relationship among the monthly and annual flow values. The simple autoregressive form of the condensed disaggregation model facilitates the use of Bayesian inference theory to describe uncertainty as to the most appropriate values of the model's parameters. This allows construction of a two stage streamflow generation procedure which captures both the uncertainty as to what the model's parameters might be and the characteristics of flow sequences a model with those parameters might sequences a model with those parameters might generate. The differences in estimates of reservoir generate. The differences in estimates of reservoir system performance statistics due to the choice of different but reasonable models are generally relatively modest. The limited information available to estimate the parameters of the chosen model can have a striking and serious impact on the ability to specify how a given reservoir system is likely to perform in the future. Modeled sequences describe flows in the Rappahannock River in Virginia and the Boise River in Idaho. For high-reliability systems the results show that streamflow generation procedures which ignore model parameter uncerprocedures which ignore model parameter uncer-tainty can grossly underestimate reservoir system failure rates and the severity of likely shortages, even if based on a 50-year record. (Baker-IVI)

INTERANNUAL STEAMFLOW VARIABILITY IN THE UNITED STATES BASED ON PRINCI-PAL COMPONENTS,

Geological Survey, Reston, VA. H. F. Lins.

Water Resources Research, Vol. 21, No.5, p 691-701, May, 1985. 8 Fig. 3 Tab, 20 Ref.

Descriptors: *Streamflow, *Variability, *Principal component analysis, Time series analysis, Flow, Autocorrelation.

Autocorrelation.

Interannual modes of streamflow variation at 106 locations across the United States during the period 1931-1978 are defined by using principal components. Nearly 60% of the total variance could be explained by five principal components. Each component describes a spatially distinct mode of variation in terms of the departure of flows from period-of-record mean conditions. Thus the first principal component represents a uniform nationwide function; the second, a north-south opposition in flow departures; the third, an east-west opposition; the fourth, a coastal-continental opposition; and the fifth, a northern plains-southern plains opposition. Each successive principal component describes an increasingly more regional pattern of streamflow variation. These component patterns, especially the first three, exhibit considerable spatial stability based on similar analyses using altered data sets. Temporally, component stability is less certain, except in the case of

the first component. Time series analysis of component scores indicates that most component functions are best described as AR(1) processes. Component four, the coastal-continental flow opposition function, appears to be an AR(2) process. Given the characteristics of principal components to describe the most organized modes of variation in a data set, it is not surprising that four of the first five components have stronger autocorrelation functions at low lags than does mean annual streamflow. Principal components can be used to identify the primary modes of variability in large multivariate fields of streamflow data. The principal components of streamflow persistmultivariate fields of streamflow data. The principal components of streamflow exhibit more persistence than mean annual streamflow. For certain applications involving the analysis of large spatial and long temporal sets of flow data, parsimony without significant compromise in information may be achieved using principal components. (Baker-IVI)

RUNOFF FROM GLACIERIZED MOUNTAINS: A MODEL FOR ANNUAL VARIATION AND ITS FORECASTING,

Stirling Univ. (Scotland). Dept. of Environmental

R. I. Ferguson. Water Resources Research, Vol. 21, No. 5, p 702-708, May. 1985. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Snowmelt, *Runoff, *Glaciers, *Mountains, *Streamflow, Snow, Ice, Forecasting, Satellite technology, Snowcover, Snow accumulation, Remote sensing, Orographic variation.

For remote high mountain basins, such as the upper Indus in Pakistan, the only means of forecasting spring and summer runoff is from preseason snow cover on satellite images. Previous studson snow cover on satellite images. Previous stud-ies have shown that regression coefficients of runoff on snow cover differ between basins in magnitude and sign. A simple formal analysis of annual meltwater yield from high mountain basins explains why its relationship with preceding snow cover varies from basin to basin in sign and sensi-tivity and identifies a number of additional glacio-climatic parameters that are relevant but cannot be climatic parameters that are relevant but cannot be determined from preseason satellite imagery. A simple but flexible parameterization of orographic determined from preseason satellite imagery. As simple but flexible parameterization of orographic variation in snow accumulation and potential snowmelt enables prediction of annual meltwater runoff from the extent of winter snow cover, with bounds attached to allow for variation in summer heat input to glacier ablation zones. The moderating influence of glaciers on runoff gives way in highly glacierized basins to an inverse relationship between annual meltwater runoff and preceding snow cover. The critical glacier extent may be a slow as 10-20% where there is a strong orographic increase in snow accumulation. The value of satellite imagery for forecasting meltwater yield from high mountains would be improved by using late summer images to estimate glacierized areas, firn zone extent, and a latter's year to year variation. Even so there is still a need for ground investigation of the spatial, especially orographic, variation in snow accumulation and potential snowmelt. (Baker-IV) W86-00077 W86-00077

MINIMUM VARIANCE STREAMFLOW RECORD AUGMENTATION PROCEDURES, Tufts Univ., Medford, MA. Dept. of Civil Engi-

neering. R. M. Vogel, and J. R. Stedinger. Water Resources Research, Vol. 21, No. 5, p 715-723, May, 1985. 7 Fig, 4 Tab, 25 Ref.

Descriptors: *Floods, *Streamflow, *Variance, Estimating, Flood peaks, Sampling, Matalas-Jacobs estimators.

Augmentation procedures have been recognized as a useful approach for estimating the mean and variance of short hydrologic records. Approaches for augmentation of short-streamflow records have exploited the cross-correlation among flows at two or more gages to obtain maximum likelihood estimates of the mean and variance of the flows at the

Streamflow and Runoff-Group 2E

short-record gage. Estimators of the mean and variance of the flows at a short record site were derived which should have lower variance than the unbiased maximum likelihood or Matalas-Jacobs estimators for the small samples of interest in hydrology. Since the Matalas-Jacobs estimators as well as the estimators introduced in this study require an estimate of the flow's cross correlation p, a Monte-Carlo experiment was performed to evaluate the impact of using the sample cross-correlation on their root mean square error (rmse). In general, these estimators have essentially an equal or, as is more often the case, a lower rmse than the Matalas-Jacobs estimators. The sampling properties of estimators of the mean and variance of the flows at the short record site were examined. The potential advantages and limitations of these new estimators are discussed within the framework of augmentation and/or extension of both peak annual floods and also monthly streamflow records. (Baker-IVI)

UNIT HYDROGRAPH APPROXIMATIONS ASSUMING LINEAR FLOW THROUGH TOP-OLOGICALLY RANDOM CHANNEL NET-

OLOGICALLY RANDOM CHANNEL NET-WORKS, Geological Survey, Lakewood, CO. Water Re-sources Div. B. M. Troutman, and M. R. Karlinger. Water Resources Research, Vol. 21, No. 5, p 743-754, May, 1985. 4 Fig. 27 Ref, 1 Append.

Descriptors: *Runoff, *Drainage basins, *Flow, *Unit hydrographs, Mathematical equations, Laplace equation, Precipitation, Drainage, Surface flow.

One of the important processes in defining runoff response of a drainage basin, movement of water on the surface through a channel network, is considered. Infiltration, subsurface flow, and overland flow are not considered. The instantaneous unit hydrograph (IUH) of a drainage basin is expressed as a function of (alpha, beta, N), of (alpha, beta, N), D) and of (alpha, beta, N, M). The parameter alpha characterizes the link (channel segment) lengths, beta is a hydraulic parameter, N is number of first-order streams, D is diameter (mainstream length), and M is order. Obtaining the IUH may involve numerical solution of the difference equation or numerical inversion of a Laplace transform. Both of these tasks, however, are readily performed on a digital computer. The IUH is derived based on assumptions that the links are independent and identically distributed random variables and that the network is a member of a topologically random population. Linear routing schemes, including translation, diffusion, and general linear routing are used, and constant drainage density is assumed. By using (N, alpha, beta) as the fundamental basin characteristics, asymptotic (for large N) considerations lead to a Weibull probability density function for the IUH. This asymptotic IUH is identical for all linear routing schemes. (Baker-IVI) W86-00082

PROBABILISTIC STRUCTURE OF STORM

SURFACE RUNOFF,
Universidad Simon Bolivar, Caracas (Venezuela).
Graduate Program in Hydrology and Water Re-

sources.
J. R. Cordova, and I. Rodriguez-Iturbe.
Water Resources Research, Vol. 21, No. 5, p 755763, May, 1985. 7 Fig. 5 Tab, 8 Ref, 1 Append.
Venezuela National Research Council grant SI-

Descriptors: *Rainfall intensity, *Storm runoff, *Rainfall-runoff relationships, Probability, Storms, Infiltration, Mathematical equations.

The mean and variance of storm surface runoff are derived under the assumption that storm events are rectangular pulses with a bivariate exponential distribution for the intensity and duration of the storm. The Philip infiltration equation is used to make the transformation between rainfall and surface runoff. The probability of zero storm surface runoff earn and variance of storm surface runoff is also calculated under the same assumptions. The

correlation between intensity and duration of the storm has an important impact on the probabilistic structure of storm surface runoff. The correlation between intensity and duration of the storm has an important impact on the probabilistic structure of storm surface runoff. Equations are given which take into account such a correlation and provide the hydrologist with a way to estimate the mean and variance of storm surface runoff. It is not advisable to assume beforehand that intensity and duration are uncorrelated random variables, and an effort should be made to estimate the correlation between these climatic characteristics. The correlation between intensity and duration increases the probability of occurrence of storm surface runoff, which shows a significant increase for soil moisture contents above 60%. (Baker-IVI)

HYDROLOGICAL REGIONALISATION: A QUESTION OF PROBLEM AND SCALE, Vrije Univ., Amsterdam (Netherlands).

I. Simmers, and E. Seyhan.

In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of FLorida, Gainesville. p 202-214, 6 Fig. 3 Tab, 20 Ref.

Descriptors: *Streamflow, *Runoff, *Hydrologic models, *Catchment areas, *Regional analysis, *Hydrologic data collection, *Surface runoff, Data collections, Model studies, Watersheds, Land use, Spatial distribution, Models, Topography.

Spatial distribution, Models, Topography.

Parameter prediction for ungauged catchment areas and regionalization of hydrological data depend on two fundamental issues - the problem to be resolved and the scale at which a solution is required. A simplified, dynamic method for regionalization of hydrological data is presented which encompasses these issues and is currently being applied to an ongoing study in east Luxembourg. Since the problem to be resolved in two catchments (the Toilbach and the Dosbach) involves prediction of hydrological response consequent upon land use change, the scale is small and requires the consideration of the dynamic spatial variation in discharge source areas. Data collection was initiated from a regionalized sampling matrix technique according to topography, vegetative cover, and nature of surficial deposits. The watershed is thus regarded as a system which consists of a series of homogenous units each contributing to runoff formation and streamflow generation. The described approach to regionalization is considered robust and, if combined with remote sensing, should minimize instrumental and data collection requirements.

W86.00096

ADVANCEMENT IN HYDRAULIC MODEL-ING OF POROUS PAVEMENT FACILITIES, Espey, Huston and Associates, Inc., Austin, TX. G. F. Ooforth.

In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January, 27-28, 1983, University of Florida, Gainesville. p 237-254, 8 Fig. 3 Tab, 5 Ref.

Descriptors: *Urban runoff, *Porous pavement, *Surface runoff, *Storm runoff, *Simulation analysis, *Drainage engineering, *Porous mediage, *Paving, *Hydraulic models, Runoff, Models, Model studies, Urban hydrology, Hydrologic budget, Storm seepage, Asphalt.

A porous pavement facility is an innovative solution to the problems of stormwater drainage from parking and other low density traffic areas in urban landscapes. Stormwater hydraulic characteristics of porous and nonporous pavement sites were evaluated using a revised version of the computer model PORPAV. PORPAV is a two-dimensional dynamic water budget analysis of a pavement facility which was initially developed for use in the EPA Storm Water Management Model. The utilization of PORPAV allows a comprehensive analysis of flow and storage in pavement facilities to aid a comparisons of the hydraulic response of alternative pavement designs. Monitoring surveys and stormwater simulations using PORPAV were car-

ried out on three parking lots made of porous asphalt, gravel trench material, and conventional asphalt, respectively. Results showed that PORPAV satisfactorily simulated sprinkler-generated stormwater hydraulics of both porous and nonporous pavement facilities. Sprinkler application rates ranged from 0.4 to 1.7 inches/hr. Observed runoff ranged from 37 to 73% of recorded sprinkler inflow for the porous asphalt lot, 64 to 73% of recorded sprinkler inflow for the gravel trench lot and 71 to 118 volume % of recorded rainfall for the conventional asphalt lot. W86-00098

TIME-OF-TRAVEL DATA FOR NEBRASKA STREAMS, 1968 TO 1977,

Geological Survey, Lincoln, NE. Water Resources

L. R. Petri. L. R. Fell. Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-602, 1984. 63 p, 17 Fig, 20 Tab, 6 Ref.

Descriptors: *Dye-tracing, *Time-of-travel measurements, *Surface-water discharge, *Nebraska,

This report documents the results of 10 time-of-travel studies, using 'dye-tracer' methods, conduct-ed on five streams in Nebraska during the period 1968 to 1977. Streams involved in the studies were the North Platte, North Loup, Elkhorn, and Big Blue Rivers and Salt Creek. Rhodamine WT dye in a 20 percent solution was used as the tracer for all 10 time-of-travel studies. Water samples were collected at several points below each injection site. Concentrations of dye in the samples were measured by determining fluorescence of the sample and comparing that value to fluorescenceconcentration curves. Stream discharges were measured before and during each study. Results of each time-by-travel study are shown on two tables and on graph. The first table shows water discharge at injection and sampling sites, distance between sites, and time and rate of travel of the deve between sites. The second table provides de-scriptions of study sites, amounts of dye injected in the streams, actual sampling times, and actual con-centrations of dye detected. The graphs for each centrations of type detected. The graphs for each time-of-travel study provide indications of changing travel rates between sampling sites, information on length of dye clouds, and times for dye passage past given points. (USGS) W36-00120

STREAMFLOW LOSSES ALONG THE BAL-CONES FAULT ZONE, NUECES RIVER BASIN, TEXAS,

Geological Survey, Austin, TX. Water Resources

L. F. Land, C. W. Boning, L. Harmsen, and R. D.

Reeves. Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources In-vestigations Report 83-4168, 1983. 72 p, 36 Fig. 11

Descriptors: *Base flow, *Discharge measurement, Recharge, *Texas, *Streamflow losses, *Stream-flow gains, Nueces River basin, Edwards aquifer.

An investigation was conducted to quantify and to determine distribution of streamflow losses and gains that occur during base flow conditions in the Balcones Fault Zone of the Neuces River basin. The streams studied include the West Nucces, Nucces, Dry Frio, Frio, and Sabinal Rivers, and Seco, Hondo, and Verde Creeks. Discharge measurements made during storm recession flows of these streams identified direct recharge to outcrops of the Edwards aquifer and related limestones that ranged from as high as 393 cubic feet per second for the Frio River to as low as 42 cubic feet per second for the Sabinal River. Recharge to outcrops of the Buda Limestone, Eagle Ford Shale, and Austin Group also eventually reaches the Edwards aquifer, and measurements identified losses to these formations ranging from as high as 174 cubic feet per second for the Frio River to near zero for Verde Creek. (USGS) An investigation was conducted to quantify and to

Field 2—WATER CYCLE

Group 2E-Streamflow and Runoff

W86-00124

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1981 VOLUME 1: NORTHEAST FLORIDA.

Geological Survey, Orlando, FL. Water Resource

For primary bibliographic entry see Field 7C. W86-00127

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1982, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,
Geological Survey, Lakewood, CO. Water Resources Div

For primary bibliographic entry see Field 7C. W86-00128

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.
Geological Survey, Bismarck, ND. Water Re-

For primary bibliographic entry see Field 7C. W86-00129

WATER RESOURCES DATA HAWAII, OTHER PACIFIC AREAS, WATER YEAR 1981. VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRO-NESIA, PALAU ISLANDS AND AMERICAN SAMOA.

Geological Survey, Honolulu, HI. Water Resources Div.

For primary bibliographic entry see Field 7C. W86-00130

ATCHAFALAYA RIVER DELTA; REPORT 9: WIND CLIMATOLOGY, Coastal Engineering Research Center, Vicksburg, MS.

For primary bibliographic entry see Field 2L W86-00163

ATCHAFALAYA RIVER DELTA; REPORT 8: NUMERICAL MODELING OF HURRICANE-INDUCED STORM SURGE, Coastal Engineering Research Center, Vicksburg,

MS.

For primary bibliographic entry see Field 2A. W86-00164

PRELIMINARY USER'S MANUAL 3-D MATH-EMATICAL MODEL OF COASTAL, ERINE, AND LAKE CURRENTS (CELC3D). itical Research Associates of Pri

Inc., 197.
Y. P. Sheng.
Instruction Report D-84-1, April 1984. Final
Report. Army Engineer Waterways Experiment
Station, Vicksburg, MS. 52 p, 10 Fig. 3 Tab, 11 Ref, 2 Append.

Descriptors: *Finite difference methods, *Mathematical models, *Water currents, *Fluid mechanics, *Computer models, Models, Model studies, Hydrologic models, Simulation analysis, Estuaries, Lakes, Differential equations, Mathematical studies, Coastal waters.

An efficient and comprehensive three-dimensional finite-difference model of coastal, estuarine, and lake currents (CELC3D) has been developed and is currently operative on a VAX-11/780 minicomputer. This user's manual discusses the special model features, general structure of the CELC3D computer code, sub-program summary, input/output data, and data requirements, and gives an example calculation by simulating the tide- and wind-driven currents in the Mississippi coastal water of the Gulf of Mexico. The CELC3D code can be used for the computation of two- or threecan be used for the computation of two- or three-dimensional unsteady currents in coastal, estuarine, or lake waters based on the free-surface model described in detail by Sheng (1983). The present

version of the code contains no buffering scheme and is programmed to run entirely in the central memory. The CELC3D program solves the mean equations of fluid motion within a water body with respect to a right-handed Cartesian coordinate system located at the nominal water surface. These system rocated at the nominal water surface. These equations consists of the partial differential equations for surface displacement, vertically integrated velocities, three-dimensional velocities, temperature, salinity, density, and sediment concentration. W86-00168

CURRENT MEASUREMENTS IN THE CO-

LUMBIA RIVER ESTUARY, Chalmers Univ. of Technology, Goeteborg (Sweden). Institutionen foer Kaernkemi. For primary bibliographic entry see Field 2L. W86-00181

DEVELOPMENT OF A NUMERICAL MODELING CAPABILITY FOR THE COMPUTATION OF UNSTEADY FLOW ON THE OHIO RIVER OF UNSTEADY FLUW ON THE OHIO RIVER AND ITS MAJOR TRIBUTARIES, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. B. H. Johnson.

Technical Report HL-82-20, August 1982. Final Report. 154 p, 83 Fig, 7 Tab, 8 Ref, 3 Append.

Descriptors: *Rivers, *Flow characteristics, *Navigation, *Locks, *Dams, Model studies, Mathematical models, Unsteady flow, Ohio River, Reservoir operation, Tributaries, Flood control, FLOWSED model, Levees, Sediment transport.

The FLOWSED model is a one-dimensional m ematical model for predicting open-channel un-steady flow conditions and sediment movement on steady flow conductors and sediment movement on the Ohio River. In this work the coefficients were selected to minimize sediment transport. FLOWSED, an implicit finite difference model, can be used to model a system containing any number of tributaries. The influences of locks and number of tributaries. The influences of locks and dams as well as levee overtopping are also included. This model cannot be applied to multiple connected systems with closed loops or distributary channels. FLOWSED was applied to the complete Ohio River systems, broken into four separate segments, in a calibration mode. Historical data from floods in 1964, 1972, and 1976 were used. Results at gages varied from excellent to encouraging. However, poor results were obtained on tributaries where crude geometry data were used. W86-00220

CHANNEL WIDTHS IN BENDS AND STRAIGHT REACHES BETWEEN BENDS FOR PUSH TOWING: HYDRAULIC MODEL IN-

PUSH TOWING: HYDRAULIC MODEL IN-VESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 8B. W86-00225

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 6: LARVAL FISH STUDIES PILOT REPORT, Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. For primary bibliographic entry see Field 6G. W86-00226

GUIDE TO STREAM HABITAT ANALYSIS USING THE INSTREAM FLOW INCREMENTAL METHODOLOGY, Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team. For primary bibliographic entry see Field 6G. W86-00251

2F. Groundwater

DISPERSION IN ANISOTROPIC, HOMOGE-NEOUS, POROUS MEDIA, Baghdad Univ. (Iraq). Coll. of Engineering.

Q. N. Fattah, and J. A. Hoopes. Journal of Hydraulic Engineering, Vol. 111, No. 5, p 810-827, May, 1985. 6 Fig, 1 Tab, 28 Ref, 1

Descriptors: *Dispersion, *Anisotropic media, *Homogenous media, *Porous media, *Ground-water movement, *Flow, Sand, Tensor models, Vectors, Model studies, Particle size, Path of pol-

A tensor model for the dispersion coefficient for saturated flow in anisotropic, homogeneous porous media was developed through evaluations of tensor components from experiments with an anisotropic, homogeneous porous medium, constructed from thin, alternating layers of two types of sand, having different mean particle sizes. Tests were conducted for flow parallel, perpendicular, and inclined at 60 degrees to the direction of the layers. The hydraulic conductivity and the longitudinal dispersion coefficient were second-rank tensors with equal and constant eccentricities and with major and minor principal axes oriented along and perpendicular to the direction of the sand layers, respectively. The lateral dispersion coefficient was a second-rank tensor whose principal axes were orthogonal to those of the hydraulic conductivity tensor and whose eccentricity increased with increasing seepage velocity. Two values of the off-principal diagonal dispersivities were nearly equal in magnitude but opposite in sign. Experimental results support the dispersion coefficient tensor model proposed in the investigation. (Author's abstract) W86-00015

FIELD OBSERVATIONS AND NUMERICAL EXPERIMENTS ON A DRYING FRONT IN A VOLCANIC ASH SOIL CALLED KANTO

Rissho Univ., Tokyo (Japan). Dept. of Geography. M. Higuchi. Journal of Hydrology, Vol. 77, p 253-262, 1985. 5

Descriptors: *Drying fronts, *Soil water, *Volcanic ash soil, *Kanto loam, *Japan, *Evaporation, *Numerical analysis, Mathematical studies, Solar radiation, Wind, Boundary conditions, Loam.

Field observations (in Japan) and numerical experiments were carried out to investigate the formation and advance of a drying front in a volcanic ash soil called Kanto loam in an evaporation-drying process. The drying front is a boundary between an upward flux zone above and a downward flux zone beneath. In field observations of an evaporation-drying process from August 27 to September 8, 1977 in the Kanto loam, drying fronts formed quite near the soil surface and shift down to a depth of 100 cm. Numerical experiments for four different evaporation rates (respec. 1.25, 2.5, 5 and 10 mm/day) indicated that drying fronts advance downward to a depth of approximately 100 cm in 10 days. The computed depths of the drying fronts for an evaporation rate of 2.5 mm/day agree well with the observations. (Author's abstract) W86-00038

BLOCK-GEOMETRY FUNCTIONS CHARAC-TERIZING TRANSPORT IN DENSELY FIS-SURED MEDIA, British Geological Survey, Wallingford (England).

J. A. Baker.

Journal of Hydrology, Vol. 77, p 263-279, 1985. 2 Fig, 2 Tab, 22 Ref, 2 Append.

Descriptors: *Block-geometry functions, *Saturated zone, *Groundwater movement, *Solute transport, Diffusion, Heat, Geologic fractures, Path of pollutants, Laplace equation, Aquifers, Fick's law, Darcy's law, Fourier's law, Fourier analysis.

Three forms of transport are of importance in aquifers and saturated soils: transport of the water itself; transport of solutes in the water; and transport of heat by the water. Transport in saturated media can be considered to consist of densely packed blocks of matrix material separated by fis-

Groundwater-Group 2F

sures. The equations describing transport in fisured media, where transport in the matrix blocks is diffusive, are reduced to the standard form of a differential equation for the fissure phase. Transport in the matrix material is assumed to be diffusive which requires the following conditions to apply in the above three cases, respectively: water flow in the porous matrix is described by Darcy's law; water is stationary in the porous matrix and the solute transport is described by Fick's law; and water is stationary in the matrix, if it is porous, and heat transport is described by Fourier's law. Under these commonly assumed conditions the mathematical description of transport in the matrix phase will be the same in all three cases. The transport equations can be reduced to a differential equation for transport in the fissure phase along with its boundary conditions. This equation contains a dimensionless function, the block-geometry function, which contains all the relevant information regarding the geometry of the matrix blocks. Several such block-geometry functions were derived for simple shapes and for mixtures of these shapes. Empirical generalizations to irregular geometries were proposed on the basis of the commmon properties of these functions. The quasi-steady-state model of fissure-maxtrix interaction can also be formulated within this mathematical framework, and can be readily compared with the diffusive model, especially with regard to asymptotic behavior. Numerical Laplace transform inversion should be used for evaluation of the potential (head, concentration or temperature) except when the analytic solution is very simple. (Collier-IVI)

HYDRAULICS OF A WELL PUMPED WITH LINEARLY DECREASING DISCHARGE, Oovind Ballabb Pant Univ. of Agriculture and Technology, Plantagar (India). Dept. of Irriga-tion and Drainage Engineering. H. C. Sharma, H. S. Chauhan, and S. Ram. Journal of Hydrology, Vol. 77, p 281-291, 1985. 7 Fig. 10 Ref.

Descriptors: *Hydraulics, *Discharge, *Wel *Pumping, *Formation constants, *Aquifers, Thequation, Cooper-Jacob equation, Model studies

Varying the discharge rate of a well with time makes the Theis and Cooper-Jacob methods inapplicable for determination of the formation constants of an aquifer. Analytical and graphical solutions for variable discharge cases are available for a few empirical or functional relationships. A number of other modes of variation of discharge with time are physically possible. A method was developed with the help of analytical and graphical solutions to determine aquifer constants by pumping the well with linearly decreasing discharge was simulated on a horizontal Hele-Shaw model. The transmissivity and storage coefficient were evaluated by using the type curve developed for a linearly decreasing discharge well. The solution gave fairly satisfactory values of aquifer constants. (Author's abstract)

ANALYTICAL SOLUTIONS FOR PERIODIC WELL RECHARGE IN RECTANGULAR AQUIFERS WITH THIRD-KIND BOUNDARY CONDITIONS, Thessaloniki Univ., Salonika (Greece). School of Technology. P. Latinopoulos.

P. Latinopoulos. Journal of Hydrology, Vol. 77, p 293-306, 1985. 7 Fig. 1 Tab, 11 Ref.

Descriptors: "Recharge, "Rectangular aquifers,
"Aquifers, "Third-kind boundary conditions,
"Boundary conditions,
"Mathematical studies,
"Groundwater movement, Seasonal variation, Artificial recharge, Groundwater recharge, Perched Groundwater movement ficial recharge, Ground

Analytical solutions of groundwater flow in confined and unconfined homogeneous and isotropic aquifers are especially useful in understanding the physical processes on a local scale, as well as in checking numerical solutions for large-scale prob-

lems. Analytical solutions for groundwater flow in rectangular aquifers with third-kind boundary conditions in the case of a single-well recharging seasonally under any form of continuously varying recharge regime. The solutions can be used for a preliminary assessment of the groundwater response to artificial recharge schemes upon either perched aquifers or aquifers in contact with clogged river beds. Depending upon the desired final management goals, the most suitable recharge regime can be selected by trying various types of recharge rate variations at a first stage. The solutions can be used to check numerical solutions of large and more complex problems. (Collier-IVI) W86-00041

REGIONAL UNSTEADY INTERFACE BE-TWEEN FRESH WATER AND SALT WATER IN A CONFINED COASTAL AQUIFER, Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering. K. Inouchi, Y. Kishi, and T. Kakinuma. Journal of Hydrology, Vol. 77, p 307-331, 1985. 12

Descriptors: *Saline-freshwater interface, *Coastal aquifers, *Confined aquifers, *Model studies, *Naka river estuary, *Kiki river estuary, *Japan, Aquifers, Groundwater level, Water level, Mathematical equations, Boundary conditions.

matical equations, Boundary conditions.

An areal two-dimensional model to describe the unsteady motion of the fresh-salt water interface and the groundwater level in a confined coastal aquifer was applied to the confined groundwater in the estuaries of the Naka and Kiki rivers in Japan. Two equations were derived starting from the basic equations of the groundwater flow; one equation of the effective water level and one equation of the interface. The first equation describes a very rapid variation of the effective groundwater level and the second equation describes a very slow variation of the interface with time. In order to find solutions of these equations under the boundary conditions in practical field problems, the numerical scheme based on Galerkin finite-element technique was employed. Using this numerical scheme, transient positions of the groundwater level and the interface were calculated in the above-mentioned two regions and compared with the available field data. The calculated results agreed well with the data. (Author's abstract)

TWO ALGORITHMS FOR PARAMETER ESTI-MATION IN GROUNDWATER FLOW PROB-LEMS, Technische Hogeschool, Deift (Netherlands).

Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering. F. C. Van Geer, and P. Van Der Kloet. Journal of Hydrology, Vol. 77, p 361-378, 1985. 7 Fig. 1 Tab, 4 Ref.

Descriptors: *Algorithms, *Groundwater move-ment, *Piezometric head, *Model studies, Darcys law, Kalman filtering, Mathematical studies, Pumping tests.

Pumping tests.

In groundwater flow problems the system variables are groundwater levels, piezometric levels and water velocities. The state of the system is defined in accordance with the continuous or discrete formulation of the variables which describe the groundwater flow model in time and space. Groundwater movement is often described by equations based on Darcy's law and the equation of continuity. These equations contain a number of lumped parameters, representing the properties of the soil. These parameters are not known and have to be estimated from field measurements (eg, pumping tests) or from calculations. Groundwater movement can be described by one lumped parameter; two algorithms were developed to estimate that parameter based upon an optimal-state estimation with a standard Kalman filter algorithm. In both methods, existing series of groundwater levels/piezometric levels can be used. The two algorithms were applied to an example with generated data. The estimation methods may be extended to cases with more than one parameter. Both methods allow insight in the variance of the

parameter and in the reliability of the calculation results of the hydrological model. (Collier-IVI) W86-00044

ALTERNATING DIRECTION GALERKIN TECHNIQUE FOR SIMULATION OF CON-TAMINANT TRANSPORT IN COMPLEX GROUNDWATER SYSTEMS,

Waterloo Univ. (Ontario). Dept. of Earth Sciences. For primary bibliographic entry see Field 5B.

ANALYSIS AND INTERPRETATION OF SINGLE-WELL TRACER TESTS IN STRATI-

FIED AQUIFERS,
Auburn Univ., AL. Dept. of Civil Engineering.
O. Guven, R. W. Falta, F. J. Molz, and J. G. Melville.

Water Resources Research, Vol. 21, No. 5, p 676-684, May, 1985. 18 Fig, 22 Ref.

Descriptors: *Aquifer testing, *Advection, *Dispersion, Tracers, Model studies, Mathematical equations, Contamination, Path of pollutants, Groundwater pollution.

Groundwater pollution.

The definition and measurement of the dispersive properties of a stratified aquifer are investigated based on the single-well tracer test. In the single well test, tracer is pumped into the formation for a period of time and then pumped out. Concentration data are obtained from the injection-withdrawal well and from one or more sampling observation wells which may be multilevel. The analysis of such a test is based on a Lagrangian-Eulerian numerical model which considers the depth-dependent advection in the radial direction and local hydrodynamic dispersion in the vertical and radial directions. The movement of an injected tracer in a stratified aquifer may be accurately simulated without resorting to the use of a scale-dependent, full aquifer dispersivity if the flow field is known in sufficient detail. When the advection process is simulated accurately, the values of local dispersivity will be small, constant, and on the order of those measured in the field or lab at individual levels in the aquifer. The full aquifer breakthrough curves measured in observation wells in a single well test in a stratified aquifer are determined by the hydraulic conductivity profile in the region between the injection withdrawal well and the observation well if the travel distance between these wells is typical of most test geometries. The relative concentration versus time data recorded at between the injection withdrawal well and the observation well if the travel distance between these wells is typical of most test geometries. The relative concentration versus time data recorded at the injection withdrawal well during the withdrawal phase is primarily a measure of mixing in the aquifer due to local dispersion which has taken place during the experiment. The amount of mixing will depend on both the hydraulic conductivity distribution in the aquifer and the size of the experiment. As the experiment scale increases, the effects of local vertical dispersion will become larger compared to the effects of local radial dispersion. Local vertical dispersion will cause solute traveling in a high conductivity layer in an aquifer to migrate into adjacent low-conductivity layers where its movement will be relatively slow in comparison. In the initial design of a tracer test it is important to have some idea of the type of nonhomogeneity which is present. More information of a broad nature concerning the types or classifications of nonhomogeneities that exist in natural aquifers is needed. (Baker-IVI) W86-00074

STRATIGRAPHY AND SEDIMENTARY FACIES OF THE MADISON LIMESTONE AND ASSOCIATED ROCKS IN PARTS OF MONTANA, NEBRASKA, NORTH DAKOTA, SOUTH DAKOTA, WYOMING,

Geological Survey, Rolla, MO. Water Resources

Available from the Distr. Br., USGS, 604 So. Pickett St., Alexandria, VA 22304. USGS Professional Paper 1273-A, 1984. 83 p, 34 Fig, 2 Tab, 88

Field 2-WATER CYCLE

Group 2F-Groundwater

Descriptors: *Stratigraphy, *Hydrogeology, *Aquifers, Geologic units, Facies (Sedimentary), *Carbonate rocks, *Groundwater resources, *Sedimentary basins (Geologic), Permeability, *Madison Limestone, Paleogeography, Paleostructure, Limestone, Paleogeography, Paleostructure, *Marker Beds, Reefs, *Carbonate Mounds, Mon-tana, North Dakota, South Dakota, Wyoming, Ne-breaks.

The Madison Limestone study was begun in 1976 to evaluate the Madison Limestone and associated rocks as possible sources of water for the development of coal resources in the Northern Great Plains. Paleozoic sedimentary rocks in this area Plains. Paleozoic sedimentary rocks in this area include a sequence of mostly shallow-water marine include a sequence of mostly shallow-water marine carbonate, clastic, and evaporite deposits of Middle Cambrian through Late Permian age. Upper Ordovician through Upper Mississippian rocks are primarily carbonate beds containing porous units, mainly dolomite or dolomitic limestone, which are widespread but discontinuous. The Devonian and Mississippian sediments are cyclic deposits, and the Mississippian carbonate rocks can be divided into at least 13 carbonate-evaporite marker-defined cyclic units, based on the common occurrence of shaly marker beds, identifications. evaporite marker-defined cyclic units, based on the common occurrence of shaly marker beds, identified on geophysical logs. The Upper Paleozoic rocks are dominated by clastic rocks, beginning with the marine shales, carbonates, redbeds and evaporites of the Upper Mississippian and ending with the relatively thick marine and aeolian sand-stones, red beds, and evaporites of Pennsylvanian and Permian age. Thick, porous sandstone beds occur in Upper Pennsylvanian and Lower Permian rocks of Wyoming, southeastern Montana, north-western South Dakota, and southwestern North Dakota (ISGS) Dakota. (USGS) W86-00104

ANALYSIS AND INTERPRETATION OF DATA OBTAINED IN TESTS OF THE GEOTHERMAL AQUIFER AT KLAMATH FALLS,

OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.

Bources Div.

E. A. Sammel.

Available from the OFSS, USGS, Box 25425,

Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4216, 1984. 151 p, 65 Fig, 7

Descriptors: *Hydrogeology, *Reconnaissance, *Geothermal resource, Evaluation, Geology, *Oregon, Klamath County, Klamath Falls.

Water with temperatures to 130 C occurs in an extensive, heterogeneous aquifer at depths of a few hundred to nearly 2,000 feet. Chemical and isotopic analyses suggest that 190 C water mixes with cooler recharge water in a ratio of about 2 to 3 in cooler recharge water in a ratio of about 2 to 3 in zone within and beneath the aquifer. The water spreads from a fault zone and is tapped for space heating by more than 450 wells over a 2 square-mile area. Data obtained during a 50-day pumping and reinjection test in July and August, 1983, were fitted to theoretical double-porosity type curves. Predictions of water-level changes were made for two hypothetical pumping and reinjection schemes. It was determined that reinjection can generally offset declines due to pumping, although water levels will decline near pumped wells and generally offset declines due to pumping, although water levels will decline near pumped wells and will rise near injection wells. Tracer tests confirmed the double-porosity behavior of the aquifer Discharge from thermal wells averages about 540 gallons per minute and heat discharge is about 18 x 10 to the 12th power British Thermal Units per year. Down-hole heat exchangers discharge about 13 x 10 to the 10th power British Thermal Units per year. Additional development probably is feasible. (USGS)

WATER RESOURCES ON THE PUEBLO OF LAGUNA, WEST-CENTRAL NEW MEXICO, Geological Survey, Albuquerque, NM. Water Re-

Octological Survey, Alloquerque, NM. Water Resources Div. D. W. Risser, and F. P. Lyford. Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4038, 1983. 308 p, 42 Fig, 17 Tab, 45 Ref.

Descriptors: *Groundwater availability, *Surface water availability, *Groundwater movement, *Water quality, Computer modeling, *Aquifer testing, Pueblo of Laguna, *New Mexico, Bernalillo, Sandoval County, Valencia County, Cibola County, Rio San Jose Basin.

This study evaluates the quality and quantity of water available on the Pueblo of Laguna, New Mexico. Groundwater for public supply occurs in the valley fill along the Rio San Jose, in the Paguate and Encinal areas, and possibly in the northern part of the Sedillo Grant. The valley fill northern part of the Sedillo Grant. The valley fill in the Rio San Jose will supply 50 to 450 gallons per minute of potable water to properly constructed wells. In the alluvium along Rio Paguate, additional development of as much as 250 gallons per minute is possible. Groundwater for irrigation is restricted by available yields and quality to the valley fill along the Rio San Jose and possibly the western part of the Major's Ranch area. In the Rio San Jose valley yields of 50 to 450 gallons per minute of water containing 500 to 3,000 milligrams per liter are possible. Digital-model simulations of the valley-fill aquifer west of the Village of Laguna show a potential salvage of as much as 900 acre-feet per year of evapotranspiration losses if water levels are lowered. Model studies also indicate that the winter flow of the Rio San Jose could cate that the winter flow of the Rio San Jose could be used to recharge groundwater stored in the valley. (USGS) W86-00108

GROUND-WATER RESOURCES OF AUDRAIN COUNTY, MISSOURI, Geological Survey, Rolla, MO. Water Resources

Div.
L. F. Emmett, and J. L. Imes.
Available from the OFSS, USGS, Box 25425,
Lakewood, CO 80225. USGS Open-File Report
84-245, 1984. 55 p, 38 Fig, 8 Tab, 34 Ref.

*Computer model, *Groundwater Descriptors: *Computer mooes, *Groundwater movement, Groundwater irrigation, *Drawdown, *Potentiometric surface, Wells, Water supply, Groundwater availability, *Missouri, Audrain County, Enroachment, Water use, Water quality, County, Enroachmen Consolidated aquifer.

The deep (principal) aquifer in Audrain County has an average thickness of about 1,300 feet and is composed of dolomite and minor quantities of sandstone of Cambrian and Ordovician age. The deep aquifer is the source of water for all publicsupply and irrigation wells in Audrain County.

Pumpage from the deep aquifer has caused a decrease in hydraulic head of more than 200 feet since 1900 in the vicinity of the city of Mexico. Calculations from a two-dimensional digital model of the deep aquifer indicate that the drawdown would increase 10 to 25 feet from May 1979 levels in Audrain County by May 2000 in the absence of tringation pumpage and if public-supply wells continue to pump at the 1980 rate. If the additional stress due to seasonal irrigation is continued at 1980 pumping rates, 60 +/- 20 feet of drawdown is predicted by May 2000. Audrain County is the northernmost extent of freshwater in this aquifer in Missouri. In Audrain County the dissolved-solids concentration of water from this aquifer varies concentration of water from this aquier varies from 1,200 milligrams per liter in the north to less than 400 milligrams per liter in the south. Lowered water levels in the aquier may allow water with a larger dissolved-solids concentration to move into the area. (USGS) W86-00113

WATER TABLE IN ROCKS OF CENOZOIC AND PALEOZOIC AGE, 1980, YUCCA FLAT, NEVADA TEST SITE, NEVADA, Geological Survey, Lakewood, CO. Water Resources Div. G. C. Doty, and W. Thordarson. Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4067, 1983. 1 p (cover), 1 Fig (man).

Fig (map).

Descriptors: *Water table, *Maps, *Nevada, Groundwater resources, Hydrogeology, Yucca Flat, Nevada Test Site, *Nye County.

The water table at Yucca Flat, Nevada Test Site, Nevada, occurs in rocks of Paleozoic age and in tuffs and alluvium of Cenozoic age and ranges in altitude from about 2,425 feet to about 3,500 feet. The configuration of the water table is depicted by contours with intervals of 25 to 500 feet. Control for the map consists of water-level information from 61 drill holes, whose locations and age of geologic units penetrated are shown by symbols on the map. (USGS)

GROUND-WATER CONDITIONS IN THE COTTONWOOD-WEST OAKLEY FAN AREA, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, ID. Water Resources

T. K. Edwards, and H. W. Young. Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4140, 1984. 32 p, 12 Fig, 3 Tabs, 22 Ref.

Descriptors: *Groundwater development, *Water table decline, *Groundwater depletion, Groundwater barriers, *Aquifer testing, *Overdraf, *Idaho, Golden Valley, Cottonwood-West Oakley Fan, Rock Creek Hills, Critical Groundwater

Intensive groundwater development in the Cotton-wood-West Oakley Fan area, Cassia County, Idaho, has resulted in rapid water-level declines and establishment of two critical groundwater areas. A northwest-trending fault in nearly coinci-dent with the boundary between the two critical groundwater areas. Southwest of the fault, water levels in limestone are as much as 200 feet higher than those in silicic volcanics northeast of the fault, which indicates the fault is an effective harrier to than those in silicic volcanics northeast of the fault, which indicates the fault is an effective barrier to groundwater movement. Results of an aquifer test in limestone southwest of the fault further indicate no hydraulic connection with the silicic volcanics aquifer northeast of the fault. Water levels in wells completed in limestone and silicic volcanics aquifers have declined 5 and 5.5 feet per year since 1977. Groundwater withdrawals in 1980 were about 60.000 accessfore from the silicic volcanics 1977. Groundwater withdrawals in 1980 were about 60,000 acre-free from the silicic volcanics aquifer and, between 1977 and 1982, averaged about 5,300 acre-feet per year from the limestone aquifer. Annual recharge to the silicic volcanics aquifer is between about 10,000 and 26,000 acre-feet; recharge to the limestone aquifer is near 4,000 acre-feet. Limited water-quality data indicate the groundwater is chemically suitable for irrigation and domestic use. (USGS) W86-00117

STREAMFLOW LOSSES ALONG THE BAL-CONES FAULT ZONE, NUECES RIVER BASIN, TEXAS,

Geological Survey, Austin, TX. Water Resources

For primary bibliographic entry see Field 2E. W86-00124

AVAILABILITY OF WATER FROM THE AL-LUVIAL AQUIFER IN PART OF THE GREEN RIVER VALLEY, KING COUNTY, WASHING-

Geological Survey, Tacoma, WA. Water Resources Div.
W. E. Lum, II, R. C. Alvord, and B. W. Drost.
Available from the OFSS, USGS, Box 25425,
Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4178, 1984. 38 p. 12 Fig. 4
Tab, 5 Ref.

Descriptors: *Computer model, Groundwater availability, *Groundwater, *Well yield, Water resources development, Streamflow depletion, *Surface-groundwater relationships, Potential water supply, *Alluvial aquifers, Green River, King County, *Washington.

The Muckleshoot Indian Tribe plans (1982) to build a fish hatchery in part of a 1.56-square-mile area in the Green River valley, Washington, and use groundwater to operate it. Groundwater data

Water In Soils-Group 2G

were collected in the area and used in a U.S. Geological Survey two-dimensional groundwater-flow model calibrated to simulate the groundwater-flow system in the study area. Measured water levels in the alluvial aquifer were simulated to within 1 foot at 7 of 12 observation wells, and within 2 feet at all 12 wells. When pumping from the aquifer was simulated with the model, it was found that all water pumped from wells was derived from induced leakage from the Green River from the alluvium and reduced leakage through the alluvium may also reduce the flow of a tributary to the Green River. (USGS)

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1981 VOLUME 1: NORTHEAST FLORIDA.

Geological Survey, Orlando, FL. Water Resources

For primary bibliographic entry see Field 7C. W86-00127

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1962, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER.

Geological Survey, Lakewood, CO. Water Resources Div.

For primary bibliographic entry see Field 7C. W86-00128

WATER RESOURCES DATA HAWAII, OTHER PACIFIC AREAS, WATER YEAR 1981. VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRONESIA, PALAU ISLANDS AND AMERICAN SAMOA.

Geological Survey, Honolulu, HI. Water Resources Div.

For primary bibliographic entry see Field 7C. W86-00130

NATURAL GROUND-WATER-RECHARGE DATA FROM THREE SELECTED SITES IN HARVEY COUNTY, SOUTH-CENTRAL

Geological Survey, Lawrence, KS. Water Resources Div.

Source Erry.

C. A. Perry.

Available from the OFSS, USGS, Box 25425,

Lakewood, CO 80225. USGS Open-File Report

84-457, 1984. 31 p, 7 Fig, 7 Tab, 4 Ref.

Descriptors: *Data collections, Soil water, *Groundwater level, Rainfall, *Recharge, *Kansas, Equus beds, Recharge data.

The cities of Wichita, Newton, and several smaller towns pump large quantities of water from the 'Equus Beds' aquifer in south-central Kansas. The aquifer also supplies large quantities of water for irrigation at a steadily increasing rate. The Harvey County Planning and Zoning Commission entered into a cooperative agreement with the U.S. Geological Survey to collect information on natural recharge at three sites having different soils and unsaturated lithologies. Data summarized in tabular form include daily rainfall amounts, average soil moisture for selected layers, water-table levels, and neutron-measured soil moisture at 1-foot intervals. This information can be used in studying the possibility of protecting the squifer from any development that might impede natural recharge. (USGS)

USER'S GUIDE FOR A PLANE AND AXISYM-METRIC FINITE ELEMENT PROGRAM FOR STEADY-STATE SEEPAGE PROBLEMS,

rineer Waterways Experiment Station, MS. Automatic Data Processing Army Engi Vicksburg, Center.

rimary bibliographic entry see Field 2G.

PUBLIC WATER SUPPLIES IN GLOUCESTER COUNTY, N.J., Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. W. F. Hardt.

W. F. Hardt.
Water Resources Circular No. 9, New Jersey State
Dent. of Conservation and Economic Develop-Dept. of Conservation and Econorment, 1963. 55 p, 4 Fig, 5 Tab, 8 Ref.

Descriptors: "Municipal water, "Water supply, "Water demand, "Water use, "Potential water supply, Water quality, Groundwater, Water con-veyance, Aquifers, Geohydrology, Pumping plants, Saline water intrusion.

plants, Saline water intrusion.

Gloucester County is part of the Lower Delaware River Valley in New Jersey. This area is attracting new industry and has shown a population increase of about 47% from 1950-1960. The availability and quality of water is becoming more important with the economic growth of the county. Gloucester County is underlain by unconsolidated sands and clays of Quaternary. Tertiary, and Cretaceous age. The Raritan and Magothy Formations constitute the most important aquilers and yield more than 95% of the water pumped by the public water systems in the county. These formations are capable of yielding 1,400 gallons per minute (gpm) or more to large diameter wells. The overall chemical quality of the groundwater wils. The overall chemical quality of the groundwater wells. The overall chemical quality of the groundwater or contamination of groundwater by salt-water encroachment or by pollution from industrial activity or organic waste in densely populated areas should be prevented. The 21 public water systems in Gloucester County realized 100% increase in pumped water from 1948 to 1959. The history of the present installations, groundwater conditions, quality and availability of water, and potential future yield for the 21 public water systems in Gloucester County are summarized.

W86-00174 W86-00174

SEEPAGE ANALYSIS USING THE BOUNDARY ELEMENT METHOD,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.

For primary bibliographic entry see Field 2G. W86-00228

2G. Water In Soils

SOIL MOISTURE CONTENT: STATISTICAL ESTIMATION OF ITS PROBABILITY DISTRI-

Kozponti Meteorologiai Intezet, Budapest (Hunga-

ry).
T. Farago.
Journal of Climate and Applied Meteorology, Vol.
24, No. 4, p 371-376, April, 1985. 3 Fig. 29 Ref.

Descriptors: *Soil water, *Statistical analysis, *Precipitation, Surface water, Markov process, Mathematical studies, Meteorology.

Mathematical studies, Meteorology.

The simplified surface-water balance equation was generalized so as to express the probability distribution of its soil moisture component in a recurrence form; an extended probability model for soil moisture was derived based on a chain-dependent model for precipitation. A similar equation was deduced for the first moments as well. The consideration of the stochastic dependence of the consecutive daily precipitation amounts is usually unavoidable for periods essentially shorter than one month. Gamma distributions were used in fitting the stochastic variables of daily precipitation amounts. The model could have been solved only in an approximate numerical way due to its complexity. Nevertheless, either the distribution function, or, in a simpler case, the mean value of soil moisture can effectively be estimated given all parameters of the Markov process of daily precipitation, an initial value of the soil moisture and the coefficient of parameterization of other terms in the water balance equation. Such a parameterization is acceptable under the conditions of insufficient humidification. The model is illustrated by a numerical example. (Collier-IVI)

BLOCK-GEOMETRY FUNCTIONS CHARACTERIZING TRANSPORT IN DENSELY FISSURED MEDIA,
British Geological Survey, Wallingford (England).
For primary bibliographic entry see Field 2F.
W86-00039

COMPARING THE PERFORMANCE OF ROOT-WATER-UPTAKE MODELS, Katholieke Univ. Leuven (Belgium). Lab. of Soil For primary bibliographic entry see Field 2D. W86-00048

INFILTRATION UNDER PONDED CONDITIONS: 1. OPTIMAL ANALYTICAL SOLUTION AND COMPARISON WITH EXPERIMENTAL OBSERVATIONS, Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J. Y. Parlange, R. Haverkamp, and J. Touma.
Soil Science, Vol. 139, No. 4, p 305-311, April, 1985. 4 Fig, 13 Ref.

Descriptors: *Infiltration, *Ponding, *Mathematical equations, Water depth, Numerical analysis, Soil water, Differential equations, Mathematical

Under ponded infiltration the cumulative infiltration is a function of soil properties, initial conditions, and water layer thickness above the soil surface. A simple analytical infiltration formula predicted the cumulative infiltration as function of time when the soil surface is ponded. For arbitrary soil properties and arbitrary dependence of water layer thickness on time but uniform initial water content, the optimization technique predicts the cumulative infiltration from the integration of an ordinary differential equation. If the thickness of the water layer is constant with time, integration of the differential equation yields a fully analytical result. When the water layer thickness is small, the infiltration rate is significantly different from the standard Green and Ampt result; as the layer thickness increasingly accurate. Comparison with a laboratory infiltration experiment illustrated the validity of the present infiltration expressions. (Collier-IVI)

SOIL WATER EVAPORATION SUPPRESSION BY SAND MULCHES, Iowa State Univ., Ames. Dept. of Agronomy. A. S. Modaihsh, R. Horton, and D. Kirkham. Soil Science, Vol. 139, No. 4, p 357-361, April, 1985. 4 Fig, 11 Ref.

Descriptors: *Soil water, *Evaporation, *Mulches, *Sand mulch, Mulching, Evapotranspiration control, Crop production.

Experiments were performed to study sand as a soil mulch with the objective of determining the comparative effectiveness of 0-, 2-, and 6-cm-thick covering sand layers in suppressing evaporation from columns of soil. Measurements were made by using potential evaporation rates of 1.1 and 0.55 cm/d. In addition to evaporation, soil water distribution with depth was measured for the different sand-cover treatments. Five treatments were studied: check (no sand mulch), 6 cm of coarse sand (C6), 6 cm of fine sand (F6), 2 cm of coarse sand (C2), and 2 cm of fine sand (F2). After 35 d of experiment, the cumulative evaporations for the check, C6, F6, C2, and F2 treatments were measured as 6.79, 1.50, 1.55, 3.76, and 4.62 cm of water, respectively, at a potential evaporation of 1.1 cm/d and, for the potential evaporation of 0.55 cm/d, was correspondingly 6-68, 0.95, 1.21, 2.71, and 4.28 cm. These sets of numbers show that there was marked evaporation reduction for the sand mulches with respect to bare soil (check). The 6-cm sand mulches were the most effective evaporation suppressors. For equal mulch thickness, coarse sand was only slightly more effective than fine sand. Results from soil water distributions with depth for the various treatments also indicated that

Field 2-WATER CYCLE

Group 2G-Water In Soils

the sand mulches were effective in conserving soil water against evaporation losses. The mulches were effective in this order: C6 > F6 > C2 > F2. (Author's abstract) W86-00050

NUMERICAL CALCULATION OF SATURATED-UNSATURATED INFILTRATION IN A CRACKED SOIL, Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Division

M. R. Davidson.

Water Resources Research, Vol. 21, No. 5, p 709-714, May, 1985. 6 Fig, 14 Ref.

Descriptors: *Infiltration, *Soil water, Saturated flow, Unsaturated flow, Rainfall, Runoff, Mathematical equations, Wetting.

Infiltration in a nonswelling homogeneous soil containing regularly spaced, water filled, vertical cracks is calculated from a finite difference solution of the saturated-unsaturated flow equations. The numerical scheme is implicit with iteration based on the linear method of successive overrelaxation and uses a correction technique to prevent the accumulation of small iteration errors with time. Results agree well with those derived from a Green-Ampt model. Differences in cumulative infiltration and infiltration rates, expressed as perfect of the property of the prop Oreer-Ampt model. Differences in cumature in-filtration and infiltration rates, expressed as per-centages of the corresponding finite difference so-lution, are usually no more than about 4% and can be much less. Calculations predict that when the magnitude of the moistons preuct that when the magnitude of the moisture potential at the wetting front in low, the persistence of mushrooming of wetted tongues moving out of adjacent cracks results in the formation of an unwetted pocket resuits in the formation of an unwetted pocket centered on the line of symmetry when the crack spacing depth ratio is also small. As the pocket fills the infiltration rate exhibits a sudden drop caused by a corresponding rapid fall in lateral potential gradients. As moisture potential at the wetting front becomes more negative, the depth of penetration by the zone of positive pressure decreases, although penetration by the wetting front increases. (Baker-IVI)

EVALUATION OF HYDROLOGIC PROCESS-ES AFFECTING SOIL MOVEMENT IN THE HAGERMAN FAUNA AREA. HAGERMAN.

Geological Survey, Boise, ID. Water Resources

H. W. Young

Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4137, 1984. 17 p, 4 Fig, 1 Tab, 2 Ref.

Descriptors: Soil stability, *Erosion, *Perched ground water, Springs, *Agricultural runoff, *Seepage loss, Erosion control, *Idaho, Hagerman fossil beds.

The Hagerman fauna area on the western slope of the Snake River canyon in south-central Idaho is one of the most important locations of upper Pliocene fossils in the world. The fossil beds are distributed vertically through a 500-foot stratigraphic section of the Glenns Ferry Formation. Accelerated soil movement caused by surface-water runoff from irrigated farmlands on the plateau above the canyon and discharge from springs and seeps along the slope of the canyon is eroding the fossil beds. Source of the springs and seeps is a perched aquifer, which is probably recharged by seepage losses from two irrigation canals that head near the canyon rim. Annual canal losses are about 1,900 acre-feet. Annual discharge from springs and seeps is about 420 acre-feet. Corrective measures that could be taken to stabilize the soil movement and preserve the fauna area include: (1) Lining or treating the canals, (2) eliminating the practice of flushing irrigation systems, (3) constructing road berms and cross dips, and (4) estabilishing an uncultivated strip of land between irrigated farmlands and the canyon rim. (USGS)

USER'S GUIDE FOR A PLANE AND AXISYM-METRIC FINITE ELEMENT PROGRAM FOR STEADY-STATE SEEPAGE PROBLEMS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing

F. T. Tracy. Instruction Report K-83-4, September 1983. Final Report. 58 p, 21 Fig, 1 Append.

Descriptors: *Seepage, *Computer programs, *Mathematical models, Finite element method, Laminar flows, Laplace equation, Darcy's Law, Soil water movement, Groundwater movement.

This report is a user's guide for a plane and axisymmetric finite element method (FEM) computer program for solving steady-state seepage problems. Confined or unconfined, homogeneous or nonhomogeneous, and isotropic or anisotropic problems can be solved. Laplace's Equation and Darcy's Law, the equations governing laminar flow through porous media, are the basis for the analysis. is. Input to the program consists basically of per-meability data, node data, and element data. Output from the program consists of heads at the nodes, discharge velocities at the element centers, and a postprocessor file. For unconfined problems, a description of the resulting phreatic surface is also given. The report also contains some sample problems and a brief description of the theory. (Author) W86-00156

SEEPAGE ANALYSIS USING THE BOUNDARY ELEMENT METHOD,
Bureau of Reclamation, Denver, CO. Engineering
and Research Center.
A. K. Chugh, and H. T. Falvey.
REC-ERC-83-11, May 1984. 55 p, 15 Fig, 3 Tab,
18 Ref. Aprend.

18 Ref. Append

Descriptors: *Groundwater movement, *Seepage, "Soil water movement, "Infiltration, Computer models, Model studies, "Mathematical models, Steady flow, Dams, Foundations, Boundary conditions, Boundary element method, Anisotropy.

A simple and effective extension of the boundary A simple and effective extension of the boundary element method for solving basic equation of steady flow in isotropic soil is presented to solve steady confined or steady unconfined flow problems or both in zoned anisotrophic mediums. A computer program listing in FORTRAN IV and a set of user's instructions are included to facilitate set of user's instructions are included to facilitate the use of the computer program. Only steady-state seepage problems in two-dimensional domains with general distribution of piecewise homogeneous material zones are considered. Sample problems illustrating the use of the computer program and the accuracy of results are given. (Author) W86-00228

2H. Lakes

SEASONAL SUCCESSION OF PHYTOPLANK-TON IN LAKE CONSTANCE, Konstanz Univ. (Germany, F.R.). Limnological

U. Sommer. BioScience, Vol. 35, No. 6, p 351-357, June, 1985. 3 Fig, 49 Ref.

Descriptors: *Seasonal variation, *Succession, *Phytoplankton, *Lake Constance, *Austria, *Switzerland, *West Germany, Stratification, Physicochemical properties, Species composition, Mixing, Destratif

Phytoplankton succession, the physical and chemical environment, photosynthesis, zooplankton production and population dynamics, bacterio-plankton, and algal sedimentation were studied between 1979 and 1982 on Lake Constance (West Germany, Austria, and Switzerland) and phytoplankton nutrient competition was studied in steady-state and pulsed-state systems. The results of these studies were reviewed in an analysis of the relative importance of temperature, stratification, light, competition for resources, sedimentation, and losses to

heterotrophic compartments of the trophic chain in controlling seasonal shifts in phytoplankton species composition and how the importance of those factors varies during the year. In Lake Constance, the phytoplankton growth season starts when stratification begins in spring. The seasonal pattern of stratification and mixing is the master environmental variable in deep lakes like Lake Constance. Temperature and sedimentation turn out to be less important in succession than traditionally assumed. Initially, maximum growth rates are favored; later, as the water column stabilizes, zooplankton grazing and competition for nutrients become the dominant selective forces. When the mixing depth increases in autumn, algae that can tolerate low light are selected for. During the mixing period in winter, significant algal growth is impossible, the organisms become scarce, most nutrients remain unconsumed in solution, the water becomes highly transparent, and grazing and competition play no role. Shifts in species composition are caused by long-term, regular losses of water column stability, such as the autumn increase in mixing depth. (Collier-IVI) W86-00051

GROUNDWATER SEEPAGE LOADING IN A FLORIDA LAKE, NUTRIENT

Florida Inst. of Tech., Melbourne. Dept. of Envi-ronmental Sciences and Engineering. T. V. Belanger, D. F. Mikutel, and P. A. Churchill.

Water Research, Vol. 19, No. 6, p 773-781, 1985. 3 Fig, 9 Tab, 20 Ref.

Descriptors: *Groundwater movement, *Nutrient loading, *East Lake Tohopekaliga, *Florida, *Seepage, Lakes, Water quality, Piezometers, Seepage meters, Hydrologic budget.

Twenty-five seepage meters were positioned in East Lake Tohopekaliga, Florida, to determine groundwater seepage contributions of water and nutrients to the lake in 1983. Seepage was found to be an important source of water to the lake, contributing 14.3% of the water sources, and rates decreased significantly (P < 0.01) with distance from shore. A comparison of the piezometer and seepage meter techniques for measuring nutrient loading to the lake indicates the direct seepage meter technique overestimated nutrient inputs due to the enclosure to the sediments, possibly resulting in anaerobic conditions and increased release rates of ammonium nitrogen and phosphate. These results suggest that past studies employing this technique may be in error. Nutrient loading, calculated from piezometer nutrient data and seepage meter flow data, show that the groundwater nutrient loading in the lake was significant, contributing 8.7 and 17.6% of the total phosphorus and total nitrogen inputs to the lake, respectively. (Author's abstract)

UNIFIED THEORY FOR MICROBIAL GROWTH UNDER MULTIPLE NUTRIENT

Wisconsin Univ.-Milwaukee. Dept. of Civil Engi-

neering. C. Y. Chen, and E. R. Christensen. Water Research, Vol. 19, No. 6, p 791-798, 1985. 6 Fig, 2 Tab, 17 Ref. U.S. NSF grant CEE 8103650.

Descriptors: *Microbial growth models, *Limiting nutrients, *Model studies, Threshold models, Product models, Growth kinetics, Growth rates.

A unified theory for microbial growth under multiple nutrient limitation is presented. The theory has a probabilistic foundation and gives the well-known threshold and product models as special cases. The threshold model is obtained for full correlation of cell division activation levels which would occur for a single species from a single clone, growing synchronously. In contrast, the product model applies to zero correlation of the activation levels which is likely to be found in a mixed culture. The growth kinetics for each limiting nutrient acting separately, while others are at saturation, can be any of the well-known types;

e.g. Monod or exponential, or the more general logit (Moser) and Weibull models. The Weibull model is given a novel probabilistic basis. (Author's abstract)

NITROGEN AND PHOSPHORUS SPECIA-TION AND FLUX IN A LARGE FLORIDA RIVER WETLAND SYSTEM, Geological Survey, Tallahassee, FL. J. F. Elder.

Water Resources Research Vol.21, No. 5, p 724-732, May, 1985. 7 Fig, 4 Tab, 51 Ref.

Descriptors: *Wetlands, *Florida, *Apalachicola River, *Nitrogen, *Phosphorus, Nutrients, Sus-pended sediments, Chemical speciation, Dissolved solids, Nitrates, Particulate matter, Organic com-

solids, Nitrates, Particulate matter, Organic compounds.

Nutrient flux was examined in a river wetland system in northern Florida, the Apalachicola River system. The nutrient species differed substantially in the amount of net import or export from the Apalachicola River wetland system. The changes in TN and NO3-N were within the expected error of estimate, and therefore the system cannot be considered either a source or a sink for total or nitrate nitrogen. Significant net changes did occur for other nitrogen species. The system showed a distinct tendency to yield organic nitrogen, both dissolved and particulate, while consuming ammonia nitrogen. These counterbalancing processes are masked by investigation of total nitrogen alone. The flux of ammonia nitrogen was notably different from other species. The behavior of phosphorus was similar to that of nitrogen. Soluble reactive phosphorus decreased, indicating consumption within the system, whereas the remaining dissolved phosphorus showed a net yield. There appeared to be a net yield of particulate and total phosphorus, but the percent changes were barely above errors of estimate. The soluble reactive phosphorus (SRP) budget was similar to that of NH4-N. Import within the system was evident, and the loads at the headwaters and mouth of the river were nearly equal. Input by precipitation was also a significant source of SRP, approaching 10% of the total outflow. For all nitrogen and phosphorus species the predominant source was inflow from the upper watershed near Chattahoochee. The Chipola River was the second major contributor for most species. Groundwater, precipitation, and surface water runoff contributed only a small portion of the total riverine nutrient load. The relative errors of estimate of these components are larger than those of the riverine components but the overall budget is not appreciably affected by error factors associated with small components. (Baker-IVI) IVI) W86-00080

HISTORICAL CHANGES TO LAKE WASHING-TON AND ROUTE OF THE LAKE WASHING-TON SHIP CANAL, KING COUNTY, WASH-INGTON, Geological Survey, Seattle, WA. Water Resources

Div. M. J. Chrzastowski.

USGS Water-Resources Investigation Report 81-1182, 1983. 39 p, 6 Fig, 1 Tab, 41 Ref.

Descriptors: "Historical shoreline, "Shorelines, "Wetlands, "Shoreline changes, "Canals, Stream loss, Landfill, Land-use planning, Stream diversions, Lakes, Lake hydrology, Maps, "Washington, Seattle, "Lake Washington, Lake Washington Ship Canal, Lake Union, Salmon Bay, Sammamish River, Cedar River, Black River, Duwamish River, Renton, Ballard, Hiram M. Chittenden Locks, Shilshole Bay.

Historical shoreline changes to hydrologic characteristics were studied for Lake Washington and the route of Lake Washington Ship Canal. The study is based on comparison of maps made during the period 1875-1907 and modern topographic maps, supplemented with historical documents that describe the once-natural setting of the lakes and streams in the Lake Washington drainage basin. The observed shoreline changes range from minor

to substantial. The water-surface area has been historically reduced by about 6 square kilometers, and total shoreline has been reduced by 20 kilometers. Approximately 4 square kilometers of the historical wetland area has been eliminated, or about 93 percent of the natural wetland extent. The changes have resulted from construction of the Lake Washington Ship Canal and accompanying water-level adjustments, shoreline modification from urban growth of the area, and limited natural processes. The map comparison documents (1) extent of shoreline changes (2) historical loss of wetlands area, (3) loss of small streams that historically entered the lakes and bays, and (4) historical vegetation and land-use patterns around the lakeshore and canal route. The identification of historical shorelines, wetlands, and small streams that snore and canal route. The identification of nistori-cal shorelines, wetlands, and small streams that have no expression on today's landscape is infor-mation of value to land-use planning and local engineering activities. (USGS) W86-00105

PRELIMINARY EVALUATION OF LAKE SUS-CEPTIBILITY TO WATER-QUALITY DEGRA-DATION BY RECREATIONAL USE, ALPINE LAKES WILDERNESS AREA, WASHINGTON, Geological Survey, Seattle, WA. Water Resources

For primary bibliographic entry see Field 5C. W86-00114

COEFFICIENTS FOR USE IN THE U.S. ARMY CORPS OF ENGINEERS RESERVOIR MODEL, CE-QUAL-RI, Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. For primary bibliographic entry see Field 5B. W86-00153

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM PLANTS: SELECTED LIFE HISTORY INFORMATION OF ANIMAL SPECIES ON LAKE CONWAY, FL, Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. For primary bibliographic entry see Field 4A. W36-00197

VOLUNTEER LAKE MONITORING, 1981, Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control. For primary bibliographic entry see Field 5C. W86-00200

PHYTOPLANKTON-ENVIRONMENTAL INTERACTIONS IN RESERVOIRS, VOLUME II: DISCUSSION OF WORKSHOP PAPERS AND OPEN LITERATURE, Tetra Tech, Inc., Bellevue, WA. M. W. Lorenzen, D. B. Porcella, and T. M. Grieb. Technical Report E-81-13, September 1981. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vickburg, MS. 104 p, 3 Fig, 10 Tab, 101 Ref. Contract/Grant No. DACW39-78-C-0088.

Descriptors: *Lake, *Reservoirs, *Phytoplankton, *Algae, *Environmental effects, *Water quality, Model studies, Mixing, Dissolved oxygen, Oxygen, Aesthetics, Trophic level, Eutrophication, Data collections, Sampling, Numerical analysis, Mathematical models, Simulation analysis, Nutrients, Grazing, Limnology, Fish, Chlorophyll, Temperature effects, Photosynthesis.

This report is a supplement to the Proceedings of the Workshop on Phytoplankton-Environmental Interactions in Reservoirs. It is organized to provide a general perspective and interpretation of the knowledge about phytoplankton behavior in reservoirs and to discuss techniques for reservoir study. Topics included are phytoplankton effects on water quality (mixing, vertical zones, and clarity; dissolved oxygen; aesthetic effects; trophic levels), techniques for reservoir study (data collection, multivariate numerical analysis, loading models,

simulation models), and reservoir phytoplankton models, (utility, algal production and loss, trans-port, temperature, light, nutrients, grazing, typical formulations, growth and death rates, and recom-mended formulations). W86-00206

LOCATIONS AND AREAS OF PONDS AND CAROLINA BAYS AT THE SAVANNAH RIVER

Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab. J. D. Shields, N. D. Woody, A. S. Dicks, G. J.

Hollod, and J. Schalles.

Available from the National Technical Information Service, Springfield, VA 22161 as DE82015381. DP-1525 (Rev. I), May 1982. 19 p, 7 Fig. 2 Tab, 4 Ref. Contract/Grant No. DE-AC99-76SR00011.

Descriptors: *Lakes, *Ponds, *Carolina bays, Shallow water, Savannah River Plant, South Carolina.

The U.S. Department of Energy's Savannah River Plant, a 192,000-acre site in South Carolina, contains 28 ponds and 190 Carolina bays. Carolina bays are defined as elliptical depressions, usually oriented northwest-southeast, with no apparent inlet or outlet. Pat Pond, the largest pond, is 2500 acres. The mean pond area, not including Par, is 17.6 acres (range, 0.4-202.8 acres). The mean area for Carolina bays is 6.6 acres (range, 0.3-124.0 acres). Not all Carolina bays hold water; however, higher soil moisture than the surrounding land is often indicated by aquatic vegetation. W86-00263

PONDS AND LAGOONS OF HORN AND PETIT BOIS ISLANDS, MISSISSIPPI, GULF ISLANDS NATIONAL SEASHORE: THEIR PHYSICAL SIZE, LITERATURE REVIEW AND RECOMMENDATIONS FOR FUTURE REPORTS.

National Space Technology Labs., NSTL Station,

MS. Shabica, and J. Watkins.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-137067.

National Park Service, Research/Resources Management Report SER-60, January 1982. 29 p, 3 Fig, 8 Tab, 12 Ref.

Descriptors: *Ponds, *Lagoons, *Aquatic life, Oysters, Fish, Horn Island, Petit Bois Island, Gulf Islands National Seashore, Vegetation, Brackish water, Tide lands, Mississippi.

The physical size of bodies of water on Petit Bois Island and Horn Island, Mississippi, was surveyed. Petit Bois Island contains 17 ponds and lagoons (0.17 to 18.04 hectares each) covering a total of 46.26 acres, 3.2% of the island's area. Horn Island 46.26 acres, 3.2% of the island's area. Horn Island has 63 ponds and lagoons (0.08 to 53.63 hectares each) covering a total of 191.58 acres, 5.8% of the island's area. These ponds and lagoons, all brackish, are concentrated on the eastern, geologically oldest, most stable portions of the islands. Since a 1965-1966 survey, 17 ponds on Horn Island have remained relatively stable, 12 water bodies have evolved into 5 discrete ponds, 19 water bodies have evolved into 5 discrete ponds, 19 water bodies have evolved into ponds. The literature on vegetation, fish, and oysters is reviewed. Recommendations for future research are made. Several of these concern aquatic life, particularly fish and oysters. W86-00278

WAVE DATA ACQUISITION AND HINDCAST FOR SAGINAW BAY, MICHIGAN,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.

A. W. Garcia, and R. E. Jenssen. Technical Report HL-83-14, June 1983. Final Report. 69 p, 31 Fig, 4 Tab, 26 Ref, 2 Append.

Descriptors: *Lakes, *Waves, *Data acquisition, Saginaw Bay, Michigan, Storms, Wave height, Model studies, Hindcast models, Wind, Lake Huron, Damage, Adsorption, Shallow water.

Field 2-WATER CYCLE

Group 2H-Lakes

A wave-measurement system was deployed in Saginaw Bay, Michigan, for the purpose of determining the wave growth within the bay as functions of fetch and time. The wave data acquired provide the basis for development and verification of a shallow-water wave hindcast model. The hindcast model, along with 20 years of wind data, is used to perform and extremal analysis of wave conditions within Saginaw Bay. Results of the nanlysis show that a maximum significant wave height of about 8 ft is expected at the head of the bay. (Author) W86-00282

2I. Water In Plants

INTERCEPTION STORAGE CAPACITIES OF TROPICAL RAINFOREST CANOPY TREES, Boston Coll., Chestnut Hill, MA. Dept. of Geolo-gy and Geophysics. S. R. Herwitz. Journal of Hydrology, Vol. 77, p 237-252, 1985. 4 Fig, 2 Tab, 27 Ref.

Descriptors: *Interception storage, *Canopy, *Rain forests, *Trees, *Throughfall, Rainwater, Bark, Vegetation, Leaves.

The rainwater interception storage capacities of mature canopy trees in a tropical rainforest site in northeast Queensland, Australia, were approximated using a combination of field and laboratory measurements. The above-ground vegetative sur-faces of five selected species (three flaky-barked; two smooth-barked) were saturated under labora-tory conditions in order to establish their maximum interception storage capacities. Average leaf surface interception storages ranged from 112 to 161 ml/sq m. The interception storages of bark ranged from 0.51 to 0.97 ml/cu cm. These standardized from 0.51 to 0.97 ml/cu cm. These standardized interception storages were applied to estimates of leaf surface area and bark volume for 51 mature canopy trees representing the selected species in the field site. The average whole tree interception storage capacities of the five species ranged from 110 to 5281 per tree and 2.2 to 8.3 mm per unit projected crown area. The highly significant interspecific differences in interception storage capacity suggest that both floristic and demographic data are needed in order to accurately calculate a forest-wide interception storage capacity for species-rich tropical rainforest vegetation. Species with large woody surface areas and small projected crown areas are capable of storing the greatest ed crown areas are capable of storing the greatest depth equivalents of rainwater under heavy rainfall ceptin equivalents of rainwater under neavy raintail conditions. In the case of both the flaky-barked and the smooth-barked species, bark accounted for > 50% of the total interception storage capacity under still-air conditions, and > 80% under turbulent air conditions. The emphasis in past interception studies on the role of leaf surfaces in determinate he interception studies. ing the interception storage capacity of a vegeta-tive cover must be modified for tropical rainforests to include the storage capacity provided by the bark tissue on canopy trees. (Author's abstract) W86-00037

IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COMMUNITIES; VOLUME X: INDEX AND ADDENDUM TO VOLUMES I-VIII,

Washington Univ., Seattle. Coll. of Forest Re-

sources.
R. J. Chapman, and T. M. Hinckley.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB83-128132.
FWS/OBS-82/23, July 1982. Fish and Wildlife
Service, Kearneysville, WV. Eastern Energy and
Land Use Team. 110 p. 20 Fig. 6 Tab. 234 Ref, 2
Append. Contract/Grant No. 14-16-0009-953.

Descriptors: *Soil-water-plant relationships, *Vegetation, *Wetlands, *Plant populations, *Water levilons, Ecosystems, Riparian vegetation, Trees, Shrubs, Streams, Flooding, En-vironmental effects, Aquatic plants, Rivers, Water atress, Drought resistance.

This report provides the user with a summary and a general reference document for Volumes I-VIII

of the Fish and Wildlife Service series on Impact of Water Level Changes on Woody Riparian and Wetland Communities. This series reviews and synthesizes existing information on the effects of ayunieszes cassing information on the effects of water level changes on woody plants found in riparian and wetland communities. Such vegetation provides an essential component of habitat for many species of fish and wildlife throughout the United States. This index provides the reader with automatic of the earlier volumes a list of services. a summary of the earlier volumes, a list of new literature, excerpts of pertinent recent findings, and a list of errors in preceding volumes. In addition, a section on site rehabilitation has been included. (Author) W86-00254

IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COMMUNITIES; VOLUME IX: THE ALASKA

Washington Univ., Seattle. Coll. of Forest Re-

Sources.
L. C. Lee, and T. M. Hinckley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-128702.
FWS/OBS-82-22, July 1982. Fish and Wildlife Services, Kearneysville, WV. Eastern Energy and Land Use Team. 213 p, 28 Fig. 27 Tab, 156 Ref, Append. Contract/Grant No. 14-16-0009-953.

Descriptors: *Soil-water-plant relationships, *Vegetation, *Wetlands, *Plant populations, *Water level fluctuations, Ecosystems, Riparian vegetation, Trees, Shrubs, Streams, Flooding, Environmental effects, Literature review, Cold regions, Tundra, Bogs, Marshes, Swamps, Aquatic plants, Permafrost, Muskeg, Fens, Arctic, Rivers, Water Streets

Literature on wetland and riparian plant communities in Alaska is reviewed for the purposes of planning and land management. Woody plants, perennial graminoids, and many herbaceous species are included. Detailed species lists are provided for three primary divisions (tundra, subarctic, and marine) and six provinces (Arctic tundra, Brooks Range, Bering tundra, Alaska range, Yukon forest, Pacific forest). A section on species tolerance to inundation is provided. Guidelines pertaining to other ecoregions of the U.S. are not applicable to the Alaska region because of unique conditions of cold temperature, high dissolved oxygen concentrations, low plant demand for oxygen, and nitrogen-deficient soils. The appendix lists all the plants believed to occur in Alaskan wetlands. W86-00292

2J. Erosion and Sedimentation

TRANSPORT OF SUSPENDED MATERIAL IN OPEN AND SUBMERGED STREAMS, Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering. R. Winff

Journal of Hydraulic Engineering, Vol. 111, No. 5, p 774-792, May, 1985. 10 Fig, 1 Tab, 20 Ref, 1 Append.

Descriptors: *Suspended sediments, *Sediment transport, *Mathematical studies, Turbidity currents, Wind-driven currents, Efficiency concept, Energy dissipation.

One of the most useful methods used to establish sediment transport equations is based on the hypothesis that the rate of sediment transport is related to the energy dissipation of the flow. The energy exchange in streams carrying suspended material was analyzed using an efficiency concept. The efficiency is defined as the ratio between the gain in potential energy of the suspended material and the turbulent dissipation. The efficiency is not constant, but depends linearly on Shields' parameter. The linear relation was used to develop a simple formula, which describes the suspended load as a function of well-known parameters. With the results from open streams an auto-suspension the results from open streams an auto-suspension criterion was developed for turbidity currents. This criterion describes the situation when a sub-

merged current carrying suspended material nei-ther deposits nor erodes material. A calculated value of the grain size corresponds well with ob-served values from the turbidity current in Lake Mead. As no constant efficiency is present in open streams as shown in this study, it seems unlikely that this should be the case in more complicated flows such as for wind-driven currents. Because the linear relation between the efficiency and the Shields' parameter cannot easily be extended to wind-driven suspension in lakes, these kinds of phenomena need more sophisticated methods if a satisfactory description of the suspension processes is to be developed. (Collier-IVI)

SEDIMENT TRANSPORT BY IRRIGATION RETURN FLOWS IN FOUR SMALL DRAINS WITHIN THE DID-18 DRAINAGE OF THE SULPHUR CREEK BASIN, YAKIMA COUNTY, WASHINGTON, APRIL 1979 TO OCTOBER 1981

Geological Survey, Tacoma, WA. Water Resources Div.

sources Div.

P. R. Boucher.

Available from the OFSS, USGS, Box 25425,

Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4167, 1984. 149 p, 8 Fig. 14

Tab, 19 Ref.

Descriptors: *Sediment transport, Sediment yield, Sediment discharge, Suspended sediments, *Irrigation practices, Irrigation-return flow, *Water temperature, Sulphur Creek, Yakima County, *Washington, Best Management Practices, Imholf Cone readings, Suspended sediment concentrations.

Suspended sediment, water discharges, and water temperatures were monitored in four small drains in the DID-18 basin of the Sulphur Creek basin, a tributary to the Yakima River, Washington. Water outflow, inflow, and miscellaneous sites were also monitored. The information was used to evaluate the effectiveness of management practices in reducing sediment loads in irrigated areas. This study was one of seven Model Implementation Plan projects selected by the U.S. Soil Conservation Service and the U.S. Environmental Protection Agency to demonstrate the effectiveness of institutional and administrative implementation of management plans. Sediment discharges from the four basins could not be correlated with changes in management practices, because Imhoff Cone readings collected for the study showed no statistical differences between the three irrigation seasons. However, one drain acted as a sink for sediment where more lands were sprinkler irrigated; this drain had a smaller proportion of row crops than did the other three drains. (USGS) Suspended sediment, water discharges, and water W86-00112

EVALUATION OF A HYDROGRAPH SHIFT-ING METHOD FOR ESTIMATING SUSPEND-ED-SEDIMENT LOADS IN ILLINOIS

Geological Survey, Urbana, IL. Water Resources

R. Frost, Jr., and J. Mansue. Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4037, 1984. 37 p, 14 Fig, 5 Tab, 5 Ref.

Descriptors: *Suspended sediments, *Suspended load, *Hydrographs, *Transport equations, *Illinois, Sediment transport.

A hydrograph-shifting method for estimating monthly and annual suspended-sediment loads was applied to suspended-sediment records for 12 streams in Illinois. Transport equations for each station were developed and synthetic sediment-discharge hydrographs were then generated by using these transport equations and records of daily streamflow. Hydrographs were shifted to measured values of daily sediment discharge selected to represent weekly, biweekly, and monthly sampling frequencies. Estimates of monthly uspended-sediment load ranged from 16 to 326 percent of measured values. Estimates of annual sus-

Erosion and Sedimentation—Group 2J

pended-sediment loads ranged from 41 to 136 per-cent of measured values. (The method provides a reasonable means of estimating annual loads for most sites.) An experiment designed to measure the subjectivity of the method showed it to be more subjectivity of the method showed it to be more dependent on the particular days selected as control points than on the person applying the method. An evaluation of the effect of the length of record used to develop transport equations was not conclusive. Although standard errors of estimate showed no improvement, the comparison of estimated loads with measured loads showed slight improvement when 1 or 2 years of data were added to the data used to develop transport equations. (IJGGS) tions. (USGS) W86-00115

PRELIMINARY APPRAISAL OF SEDIMENT SOURCES AND TRANSPORT IN KINGS BAY AND VICINITY, GEORGIA AND FLORIDA, Geological Survey, Doraville, GA. Water Rees Div.

J. B. McConnell, D. B. Radtke, T. W. Hale, and G. R Buell

USGS Water-Resources Investigation Report 83-4060, 1983. 68 p, 23 Fig, 15 Tab, 32 Ref.

Descriptors: *Suspended sediment, *Sediment transport, *Estuaries, Velocity, Salinity, Temperature, *Georgia, Camden County, Florida, Nassau

Water-quality, bottom-material, suspended-sediment, and current-velocity data were collected during November 1981 in Kings Bay and vicinity to provide information on the sources and transport of estuarine sediments. Kings Bay and Cumberland Sound, the site of the Poseidon Submariae port of estuarine sediments. Kings Bay and Cumberland Sound, the site of the Poseidon Submarine Base in southeast Georgia, are experiencing high rates of sediment deposition and accumulation, which are causing serious navigational and operational problems. Velocity, bathymetry, turbidity, and bottom-material data suggest that the area in the vicinity of lower Kings Bay is accumulating deposits of suspended sediment transported from Cumberland Sound on the floodtide and from upper Kings Bay and the tidal marsh drained by Marianna Creek on the ebbtide. Suspended-sediment discharges computed for consecutive 13-hour ebbtides and floodtides showed that a net quantity of suspended sediment was transported seaward from upper Kings Bay and Marianna Creek. A net landward transport of suspended sediment computed at the St. Marys Entrance may be supplying sediment to the shoaling areas of the estuary, including lower Kings Bay. (USGS)

RUNOFF, SEDIMENT TRANSPORT, AND WATER QUALITY IN A NORTHERN ILLI-NOIS AGRICULTURAL WATERSHED BEFORE URBAN DEVELOPMENT, 1979-81, Geological Survey, Urbana, IL. Water Resources

LIV.
H. E. Allen, Jr., and J. R. Gray.

Available from the OFSS, USGS, Box 25425,
Lakewood, CO 80225. USGS Water-Resources Investigation Report 82-4073, 1984. 55 p, 15 Fig, 11

Tab, 23 Ref.

Descriptors: *Sediment discharge, *Storm runoff, *Rainfall, *Agricultural runoff, Water pollution sources, Sediment transport, *Sediment yield, *Peak discharge (water), Streamflow, *Agricultural watershed, Erosion, Land use, Water quality, Soil surveys, Particle size, Bedload, Water temperature, Specific conductivity, Dissolved solids, Chemical analysis, Gaging stations, *Illinois, *Upper Spring Creek watershed, Rockford (IL), Storm characteristics, Urban construction, Erosion potential, Land cover.

A study designed to quantify and evaluate changes in runoff and sediment transport attributable to construction activities during urban development of a watershed required identification of pre-construction hydrologic conditions. Data collected before construction as 2.91 cm. (7.28 cm.) before construction on a 2.81 sq m (7.28 sq km) agricultural watershed (upper Spring Creek) near Rockford, IL, show that during a 2-year period

ending June 30, 1981, 2,890 tons (2,620 Mg) of suspended sediment were transported from the wasuspended sediment were transported from the watershed. Of the 2,890 tons (2,620 Mg), 2,690 tons suspended seculent were transported troit file was tershed. Of the 2,890 tons (2,620 Mg), 2,690 tons (2,440 Mg) or 93.1 % were transported during a storm in a 46.6-hour period of June 13-14, 1981. Runoff from a 0.031 sq m (0.080 sq km) subbasin (Spring Creek tributary) transported 33.9 tons (30.9 Mg) of suspended sediment during a 3.2-hour storm period on June 13, 1981. Regression models relating storm suspended-sediment yields and peakwater discharge per square mile for upper Spring Creek and Spring Creek tributary have average standard errors of 57 and 24 %, respectively. Trace amounts of currently banned pesticides, including Aldrin and DDT, were detected in streambed material samples. Documented sediment yields, chemical quality, and relations between runoff and sediment discharge provide baseline information for future evaluation of hydrologic conditions in the watershed. (USGS) W86-00133

SOURCES, COMPOSITION, AND TRANS-PORT OF SUSPENDED PARTICULATE MATTER IN LOWER COOK INLET AND NORTHWESTERN SHELIKOF STRAIT, ALASKA, National Occasions of American

National Oceanic and Atmospheric Administra-tion, Seattle, WA. Pacific Marine Environmental T ah

R. A. Feely, and G. J. Massoth. NOAA Technical Report ERL 415-PMEL 34, January 1982. 28 p. 17 Fig, 2 Tab, 28 Ref.

Descriptors: *Particulate matter, *Chemical analysis, *Seasonal distribution, *Sediment transport, Suspended load, Salinity, Bays, Estuaries, Cook Inlet, Shelikof Strait, *Alaska, Tides, Currents.

The chemical composition and seasonal distribu-tion of suspended particulate matter collected during 1977 and 1978 in lower Cook Inlet and northwestern Shelikof Strait are compared with published data on current patterns. With respect to suspended-matter dispersal patterns, Cook Inlet shows characteristics of both an estuary and an suspended-matter dispersal patterns, Cook Inlet shows characteristics of both an estuary and an embayment. Estuarine characteristics are exemplified by the association of the inorganic terrestrial material from upper Cook Inlet with the outward-flowing estuarine water. Plots of total suspended-matter concentrations versus salinity for surface and near-bottom waters are roughly linear for the central region of lower Cook Inlet, indicating that dilution of the estuarine water by relatively nonturbid oceanic water is the major factor controlling suspended-matter concentrations in the inlet. Embayment characteristics are indicated by the cross-channel suspended-matter gradients and by the elemental ratios of the particulate matter, which show evidence for movement of Copper River-derived aluminosilicate material across the mouth of the inlet and into Shelikof Strait. These features, which are unique to lower Cook Inlet, are a direct result of the unusual nature of the current patterns existing within the inlet. (Author) W86-00150

SUSPENDED PARTICULATE MATTER IN EL-

onal Oceanic and Atmospheric Administra-Seattle, WA. Pacific Marine Environmental National Ocea

E. T. Baker. NOAA Technical Report ERL 417-PMEL 35, March 1982. 44 p, 34 Fig, 7 Tab, 17 Ref.

Descriptors: *Particulate matter, Suspended load, *Suspended solids, *Suspended sediment, Distribution, Sediment transport, Elliott Bay, Puget Sound, Bays, *Washington.

The distribution and transport of suspended particulate matter (SPM) in Elliott Bay, an embayment of Puget Sound, Washington, was compared for dry (August) and wet (February) seasons of 1979-1980. During both survey times, the SPM distribution throughout the bay consisted of 1) a thin (< 5 m) surface layer of variable SPM concentration dominated by phytoplankton growth in summer and Duwamish River runoff in winter, 2) a uniform mid-depth minimum-SPM zone, and 3) a

bottom nepheloid layer of concentrations and thickness highly variable in space and time. The total mass of SPM in Elliott Bay was about 20% higher in February (15.7 to the 8th g) than in August (13.0 to the 8th g). Scatter plots of salinity vs. SPM for both seasons indicate a strong negative correlation (r=.95) in the surface water and a weaker positive correlation (r=.52) in the bottom waters. Vertical and horizontal transport of SPM was measured with sediment traps and current meter/transmissometer deployed at two stations. Accumulation of settled SPM 5 m above the bottom was 16%-30% higher in summer (approximately 34.5 g/sq m/day) than in winter (26.8 g/sq m/day). Organic matter made up 6.9%-12.3% of the trapped sediment. Cross-spectral analysis between near-bottom velocity and SPM concentration showed significant coherency at tidal frequencies. Transport of the SPM was dominated by the mean flow, and diffusion components had little influence. The high positive correlations between SPM concentrations and current speed imply that advection plays a larger role than resuspension in maintaining the bottom nepheloid layer in Elliott Bay. (Author) W86-00151

SEDMNT: A SEDIMENT TRANSPORT SUB-MODEL BASED ON HYDRODYNAMIC PRIN-CIPLES FOR THE UNIFIED TRANSPORT MODEL,

Oak Ridge National Lab., TN. Environmental Sciences Div

ences Liv. D. M. Hetrick, M. R. Patterson, and A. L. Sjoreen. Available from the National Technical Information Service, Springfield, VA 22161 as DE82008904. ORNL_TM-7831, March 1982. 121 p. 5 Fig. 2 Tab, 11 Ref. 4 Append. Contract/Grant No. W-7405-pg. 24 eng-26.

Descriptors: *Computer programs, *Sedimenta-tion, *Computer models, *Mathematical models, *Sediment transport, Streams, Channel flow, Ero-sion, Scour.

SEDMNT is a computer code written to model the movement of sediment through a stream channel, and is based on the SEDONE model. The mathematical model of SEDMNT consists of a system of coupled, ordinary differential equations for sediment concentration (by size class) which are solved by the Runge-Kutta-Gill integration scheme. Sediment of selected size classes is resident in the channel bed and enters the channel with stream flow. Transportation, erosion, or deposition of sediment may occur for each size class depending on the amount of sediment present and with stream flow. I ransportation, erosion, or deposition of sediment may occur for each size class depending on the amount of sediment present and the stream volume, velocity, and turbulence. Input to the model includes flow data from the calling program (UTM) and initial sediment concentrations provided by the user. Output includes a listing of the input and calculated sediment concentrations for selected time steps. Thorough testing of SEDMNT within the framework of UTM will not be possible until a complete data set is available. SEDONE, the basis of SEDMNT, has been thoroughly tested with data from the Hudson, Missispipi, and Atchafalaya Rivers. This testing was done by running SEDMNT with a stand-alone driving program rather than within UTM. It is possible that additional adjustment of the empirical parameters in SEDMNT will be needed as better test data becomes available. The results obtained from SEDMNT for the Walker Branch Watershed are encouraging. Past success with the SEDONE model implies that SEDMNT can be used to produce useful information on the possible fate of transported sediment. transported sediment. W86-00155

BUHNE POINT, HUMBOLDT BAY, CALIFOR-NIA, DESIGN FOR THE PREVENTION OF SHORELINE EROSION: HYDRAULIC AND NUMERICAL MODEL INVESTIGATIONS, Coastal Engineering Research Center, Vicksburg,

For primary bibliographic entry see Field 4D. W86-00169

Group 2J—Erosion and Sedimentation

SHORE STABILIZATION WITH SALT MARSH

Coastal Engineering Research Center, Fort Bel-

For primary bibliographic entry see Field 8G. W86-00189

HYDROCARBONS ASSOCIATED WITH SUS-PENDED MATTER IN THE GREEN RIVER, WASHINGTON,

National Oceanic and Atmospheric Administra-tion, Seattle, WA. Pacific Marine Environmental Lab.

For primary bibliographic entry see Field 5B.

W86-00196

SAND RESOURCES AND GEOLOGICAL CHARACTER OF LONG ISLAND SOUND, Coastal Engineering Research Center, Fort Belvoir, VA. For primary bibliographic entry see Field 8E. W86-00205

STREAM CHANNEL STABILITY ASSESS-MENT,

Geological Survey, Menlo Park, CA.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118190. Report No. FHWA/RD-82-021, January 1982. Final Report. Federal Highway Administration, Washington, DC. 42 p, 33 Fig. 2 Tab, 44 Ref. Coontract/Grant No. DTFH61-81-P-30085.

Descriptors: *Erosion, *Streams, *Hydraulic structures, *Bridges, *Channel morphology, Streambanks, Channel scour, Scour, Channel erosion, Alluvial channels, Highways, Roads, Unstable channels, Bank, erosion, Stream erosion, Stream banks, Maps, Aerial photography, Photography, Meanders, Braided streams, Degradation, Thalweg.

A simple method for determining relative stability of streams is based on stream morphology. This is useful for planning highway bridges. Channel instability is manifested as lateral bank erosion, progressive streambed degradation, or natural scour and fill of the streambed. Four major stream types are distinguished, based on variability of width and presence of bars: equivvidth, point bar; wide-bend, point bar; braided, point-bar; and braided, no point bars. Measurements of bank erosion on a group of 36 streams show that equivoidth streams have the highest. Erosion rates increase with stream size. Lateral stability may be measured by field assessment, repetitive surveys of channel with stream size. Lateral stability may be measured by field assessment, repetitive surveys of channel cross section, and measurement on air photos and maps. Methods for assessing channel degradation include field studies, changes in elevation of the water surface or channel bottom and hydraulic analysis. The degree of meandering and degree of channel instability are unrelated. Natural scour and fill occurs by three different mechanisms, all relevant to bridge pier depth: bed form migration, convergence of flow, and shift of thalweg or braids within a channel. W86-00214

DEVELOPMENT OF A NUMERICAL MODELING CAPABILITY FOR THE COMPUTATION OF UNSTEADY FLOW ON THE OHIO RIVER AND ITS MAJOR TRIBUTARIES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 2E. W86-00220

EFFECTS OF BEACH NOURISHMENT ON THE NEARSHORE ENVIRONMENT IN LAKE HURON AT LEXINGTON HARBOR (MICHI-

GAN), Coastal Engineering Research Center, Fort Bel-For primary bibliographic entry see Field 6G. W86-00224

DESIGN FOR PREVENTION OF BEACH ERO-SION AT PRESQUE ISLE BEACHES, ERIE, PENNSYLVANIA: HYDRAULIC MODEL IN-

Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00257

MATHEMATICAL MODEL, SERATRA, FOR SEDIMENT-CONTAMINANT TRANSPORT IN RIVERS AND ITS APPLICATION TO PESTICIDE TRANSPORT IN FOUR MILE AND WOLF CREEKS IN IOWA.
Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 5B. W86-00259

ANSWERS (AREAL NONPOINT SOURCE WATERSHED ENVIRONMENT RESPONSE SIMULATION) USER'S MANUAL. Purdue Univ., Lafayette, IN. Dept. of Agricultural For primary bibliographic entry see Field 4D. W86-00287 Engineering.

2K. Chemical Processes

AVERAGE RAINWATER PH, CONCEPTS OF ATMOSPHERIC ACIDITY, AND BUFFERING IN OPEN SYSTEMS, Texas Univ. at Austin. Dept. of Environmental Health Engineering. For primary bibliographic entry see Field 5B. W86-0001

ANALYSIS AND INTERPRETATION OF DATA OBTAINED IN TESTS OF THE GEOTHER-MAL AQUIFER AT KLAMATH FALLS, OREGON,

Geological Survey, Menlo Park, CA. Water Resources Div. For primary bibliographic entry see Field 2F. W86-00107

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF THE MOUNT SIMON-HINCKLEY AQUIFER, SOUTHEAST

MINNESOTA, Geological Survey, St. Paul, MN. Water Resources Div.

R. J. Wolf, J. R. Ruhl, and D. G. Adolphson. USGS Water-Resources Investigation Report 83-4031, 1983. 2 p, 14 Fig, 3 Tab, 19 Ref.

Descriptors: *Groundwater, *Water quality, *Aquifers, *Maps, Minnesota, Hollandale embayment, Twin Cities basin.

ment, Twin Cities basin.

The Mount Simon-Hinckley aquifer comprises a thick sequence of sandstone, siltstone, and shale that underlies southeast Minnesota. It is an important aquifer in the Hollandale embayment and in the populous Twir Cities metropolitan area, where it supplies about 10 percent of the groundwater used. Withdrawals increase significantly north of the Twin Cities basin, but some additional development of water supplies is still possible. Yields to wells are generally about 500 gallons per minute but may be as much as 2,000 gallons per minute locally. Dissolved-solids concentrations are slightly lower than in water from other aquifers in the Hollandale embayment and range from about 100 milligrams per liter in the north to as much as 2,400 milligrams per liter in the south. Dominant water type is calcium magnesium bicarbonate, however, sodium chloride-type water is found at depth. Water from the aquifer locally contains iron and manganese in concentrations greater than 1 milligram per liter. (USGS)

QUALITY OF WATER, QUILLAYUTE RIVER BASIN, WASHINGTON, Geological Survey, Tacoma, WA. Water Re-

sources Div.

M. O. Fretwell.

Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4162, 1984. 96 p, 24 Fig. 16 Tab, 35 Ref.

Descriptors: *Water quality, *Groundwater, *Surface water, *Estuaries, Quileute Indian Reservation, Quillayute River, *Washington.

tion, Quillayute River, *Washington.

Groundwater in Quillayute River basin is generally of the calcium bicarbonate type, although water from some wells is affected by seawater intrusion and is predominantly of the sodium chloride type. The water is generally of excellent quality for most uses. River-water quality was generally excellent, as evaluated against Washington State water-use and water-quality criteria. Fecal coliform concentrations in all major tributaries met State water-quality criteria; water temperatures occasionally exceeded criteria maximum during periods of warm weather and low streamflow. Nutrient concentrations were generally low to very low. The four largest lakes in the basin were temperature-stratified in summer and one had an algal bloom. The Quillayute estuary had salt-wedge mixing characteristics; pollutants entering the salt wedge tended to spread to the too of the wedge. Upwelling ocean water was the major cause of the low dissolved-oxygen concentrations observed in the estuary, however, were increased by the upwelling ocean water was the major cause of the low dissolved-oxygen concentrations in the estuary, however, were increased by the upwelling ocean waters. estuary; ammonia concentrations in the estuary, however, were increased by the upwelling ocean waters. As in the rivers, total-coliform bacteria concentrations in the estuary were greater than fecal-coliform concentrations, indicating that many of the bacteria were of nonfecal origin and probably originated from soils. (USGS)

W86-00111

INVESTIGATION OF WAIKELE WELL NO. 2401-01, OAHU, HAWAII: PUMPING TEST, WELL LOGS AND WATER QUALITY, Geological Survey, Honolulu, HI. Water Re-

Geological Survey, Honolulu, HI. sources Div.

sources Div.

P. R. Eyre.

Available from the OFSS, USGS, Box 25425,

Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4089, 1983. 38 p, 9 Fig, 5

Tab, 6 Ref.

Descriptors: *Groundwater quality, *Irrigation return flow, *Ghyben-Herzberg groundwater lens, *Aquifer testing, Oahu, *Hawaii, Basalt aquifer.

Field testing, Oath, Tawan, basar aquitet.

2401-01) near the confluence of Waikele and Kipapa Streams, Oahu, Hawaii, can be reactivated to produce potable water at a rate of 400-500 gallons per minute. Previous tests in 1946 and 1954 indicated that the well tapped the brackish transition zone which inderlies the Ghyben-Herzberg lens of the Pearl Harbor aquifer. Results of this study, based on geologic and geophysical logs of the wall, as well as on pumping test and water-quality data, indicate that the slightly brackish water produced by the well results from brackish irrigation return water. It does not appear that pumping from this well will cause seawater upconing or intrusion. (USGS)

EFFECTS OF ACID RAIN ON SOIL AND WATER.

cticut Agricultural Experiment Station, New Haven.

E. C. Krug, and C. R. Frink. Bulletin 811, November 1983. 45 p, 6 Fig, 7 Tab, 299 Ref.

Descriptors: "Acid rain, "Acidic water, "Acidic soils, "Chemical properties, "Land use, Organic acids, Air pollution, Forest watersheds, Forest soils, Water pollution, Leaching, Aluminum, Reforestation, Water pollution sources.

The impact of acid rain on soil and water can only be judged by placing it in perspective with the natural processes of soil acidification. Most of the natural acidity of rain is due to H2CO3, a weak acid that does not completely dissociate. The acidi-

Estuaries—Group 2L

ty of rain can also be expressed in terms of its ability to neutralize basic substances such as limestone. Man-made inputs are very small when compared with normal agricultural amendments with stone. Man-made inputs are very small when compared with normal agricultural amendments with imestone, or with the tremendous amounts of scidity produced in forest soils on highly siliceous parent material. Acidity in soils is generated by biological decomposition which creates oxides of C, N, and S that react with water to form acids. Because cation exchange reactions are rapid, extra H ions from acid rain could leach nutrient cations from the soil. Despite chemical and biological evidence that acid rain will not enhance leaching of nutrient cations from the acid forest soils of the Northeast, southeastern Canada and Scandinavia, misconceptions about the nature of soil acidity sustain the notion that acid rain is increasing acidification of soil and water. Another misconception is that the rate of acid production in soil is equal to the rate of mineral weathering plus acid export. The largest cause of acidification of lakes and streams is generally the revegetation and reforestation of disturbed land. The degree to which acid rain may be accelerating this process needs to be evaluated on a watershed basis.

DISSOLVED METHANE CONCENTRATIONS IN THE SOUTHEAST BERING SEA, 1980 AND

1901, Science and Education Administration, Fort Lauderdale, FL. Aquatic Plant Management Lab. C. N. Katz, J. D. Cline, and K. Kelly-Hansen. NOAA Data Report ERL PMEL-6, July 1982. 194 p, 4 Ref, 3 Append.

Descriptors: *Methane, *Water Quality, Water chemistry, *Data collections, *Chemical analysis, Salinity, Solubility, *Bering Sea.

Salinity, Solubility, *Bering Sea.

Dissolved methane was measured in the southeastern Bering Sea as a part of the Outer Continental Shelf Environment Assessment Program, administered by the National Oceanic and Atmospheric Administration. Methane analysis was routinely done in the field using a purge and trap technique, followed by quantitation on a Hewlett-Packard 5710 A gas chromatograph. The data presented are organized in a hierarchy of cruise (chronological order), station and depth distribution. Station data include: station number, latitude and longitude to the nearest tenth of a degree; local data and time of sampling, Greenwich Mean Time zone, and depth to the bottom in meters. Depth information includes: depth of the sample in meters, water temperature in degrees centigrade, salinity in grams per kilogram, sigma-t, dissolved methane concentration in nanoliters of methane gas per liter seawater corrected to standard temperature and pressure (STP), dissolved methane equilibrium solubility, and the methane solubility ratio (C/C*), which is the ratio of the observed methane concentration to the equilibrium solubility methane concentration.

W86-00180 tion. W86-00180

KARNES COUNTY, TEXAS, AREA HYDRO-CHEMICAL AND STREAM URANIUM ORI-ENTATION STUDY,

Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.

K. F. Steele

National Uranium Resource Evaluation Program, Report No. DPST-81-141-18, April 1982. 14 p, 1 Fig, 6 Tab, 5 Ref. Contract/Grant No. DE-AC09-76SR00001.

Descriptors: *Geochemistry, *Uranium, *Ground-water, *Water analysis, Wells, Mineral industry, Water pollution sources, Fate of pollutants, Karnes County, Texas, Surface water, Sediments, Bed sediments, Suspended sediments.

Groundwater sampling may be an effective method of sampling for uranium deposits in South Texas. Stream and groundwater samples were collected over and near known uranium deposits. The stream water quality parameters were more constant than the groundwater parameters. For example, pH was 7.5-8.5 in surface water, 6.2-9.1 in groundwater; conductivity was 1100-2300 microm-

hos/cm in surface water, 54-8900 micromhos/cm in groundwater; uranium, < 4 to 25 parts per billion in surface water, about 2 parts per million in stream sediment, and < 4 to 66 parts per billion in groundwater. Samples with high uranium levels were collected in wells penetrating known ore zones. Sulfate levels were also high in high-uranium samples.

2L. Estuaries

TRACER APPLICATIONS OF ULTRA-VIOLET ABSORPTION MEASUREMENTS IN COAST-

AL WATERS,
University Coll. of North Wales, Menai Bridge.
Marine Science Labs.

P. Foster. Water Research, Vol. 19, No. 6, p 701-706, 1985. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Environmental tracers, *Ultraviolet absorption, *Coastal waters, *Absorption, Radiation, Tracers, Organic compounds, Inorganic compounds, Nitrates, Bromides.

The ultra-violet absorption properties of natural waters may be used as a tracer for following the distribution of source waters in coastal water systems. Measurements can be made readily upon sample collection and filtration on board ship. The sample collection and filtration on board ship. The form of the spectrum can be considered as two distinct sections: within the spectral region 250-350 nm modifications of the UV absorption are direct manifestations of changes in the concentration and/or nature of the dissolved organic matter; below 250 nm inorganic species, such as nitrate and bromide, in addition to the dissolved organic matter, contribute to the absorption. UV data was collected during two winter cruise off the west collected during two winter cruises off the west coast of Great Britain. Four absorption indices were developed as being of potential tracer value to mixing studies in coastal waters. The intensity to mixing studies in coastal waters. The intensity factor in the organic region of the spectrum was numerically evaluated as the integrated absorption (Sigma A) between 250 and 350 nm, while the magnitude of the absorption at 225 nm (A225) was adopted as the intensity factor for the composite region. The organic and composite shape factors were evaluated as the absorption ratios, A250/A275 and A225/A250, respectively. In March salinity was highly correlated with Sigma A. Off-shore waters were characterized by high salinities and low values of Sigma A. Coastal waters of low salinity and high Sigma A formed the other end member and in contrast to the analogous mixing diagram for December there was no clear distinction between bay and coastal waters with respect diagram for December there was no clear distinction between bay and coastal waters with respect to their Sigma A loading. The relationship which best met the tracer criterion of a low correlation coefficient was that between salinity and the intensity factor A225; this relationship provided a very effective separation of three water types. A marked temporal change in the absorption characteristics was associated the waters in particular areas. As a consequence, the most effective combination of tracer indices at one time of year may not necessarily be the most effective combination at another. (Collier-IVI) W86-00056

EFFECTS OF SPATIAL VARIATION IN AM-EFFECIS OF SPATIAL VARIATION IN AMPLITUDE AND PHASE OF THE OSCILLATORY TIDAL CURRENTS ON THE RESIDUAL LAGRANGIAN DRIFTS, Delaware Univ., Newark. Coll. of Marine Studies. K.-C. Wong. Water Resources Research, Vol. 21, No. 5, p 769-774, May, 1985. 6 Fig. 5 Ref.

Descriptors: *Tidal currents, *Estuarine environ-ment, *Lagrangian circulation, Circulation, Water currents, Tidal waters, Spatial distribution, Veloci-

The understanding of the characteristics of residual Lagrangian circulation in estuaries is important, since the transport of dissolved or suspended material is a Lagrangian phenomenon. The basic baraicis of residual Lagrangian drifts under the influ-

ence of oscillatory tidal currents with spatial varience of oscillatory tidal currents with spatial variations in amplitude and phase are examined analytically for relatively simple Eulerian velocity fields. Intense residual Lagrangian drifts are generated by strong spatial velocity gradients and the residual drifts at any given location are heavily dependent on the initial release time relative to the phase of the tidal current. A relatively weak mean flow can interact with the tidal currents and produce significant modification of the residual drifts as well as their dependency on the initial conditions. Both their dependency on the initial conditions. Both the magnitude and the direction of the mean flow the magnitude and the direction of the mean flow are important in affecting the dependency of the residual drift estimates on the initial conditions. The presence of strong spatial variation in tidal current may render the approximation of some equations invalid so estimation of residual Lagran-gian drifts based on limited Eulerian measurements will lead to large errors under these circumstances. Strong spatial gradients in tidal currents are able to induce intense residual Lagrangian drifts and these Strong spatial gradients in tidal currents are able to induce intense residual Lagrangian drifts and these residual drifts depend strongly on the release time relative to the phase for the tidal currents. Given a tidal current field with strong spatial gradients, a relatively weak mean flow can modify the residual drifts as well as their dependency on the initial conditions significantly. The mean flow direction is very important to the residual drift estimates. (Baker-IVI) W86-00085

CIRCULATION IN THE LOWER COOK INLET, ALASKA,

National Oceanic and Atmospheric Administra-tion, Seattle, WA. Pacific Marine Environmental

R. D. Muench, J. D. Schumacher, and C. A.

NOAA Technical Memorandum ERL PMEL-28, July 1981. 26 p, 10 Fig, 2 Tab, 32 Ref.

Descriptors: *Water currents, *Tidal currents, *Flow rates, Ocean currents, Flow pattern, Flow, Cook Inlet, Shelikof Strait.

Circulation in the lower Cook Inlet region has Circulation in the lower Cook Inlet region has been described and discussed utilizing current observations obtained during October 1977-October 1978. The major circulation feature was a mean westerly flow which entered the region via Kennedy and Stevenson entrances, parallels the 100-m isobath through the lower Inlet, then exits the system via Shelikof Strait. Summer mean current speeds in this flow were 10-15 cm/s. Winter speeds were 25-30 cm/s. A secondary circulation feature was present as a southward flow which occupied the western portion of the lower Inlet. Summer current speeds here were 15-20 cm/s, while winter speeds were of order 10 cm/s. The westerly flow is speeds were of order 10 cm/s. The westerly flow is driven in summer primarily by a baroclinic field consequent to coastal freshwater input (the Kenai Current), while in winter this flow is driven to a Current), while in winter this flow is driven to a greater extent by wind-driven coastal convergence and possibly by an alongshore pressure gradient set up by the Alaskan Stream. The southward flow, driven by freshwater input into upper Cook Inlet, therefore is larger in summer when this input is greater. Mean flow in the eastern lower Inlet was weak and variable in all seasons. Low-frequency and tidal flow fluctuations were superimposed upon the mean flow, and in regions of low mean speeds, controlled the instantaneous flow. The low-frequency fluctuations were associated with westerly flow through the system. Tidal current were large (70-100 cm/s) and primarily semidiurwere large (70-100 cm/s) and primarily semidiur-nal in the eastern portion of the the lower Inlet and in the Kennedy and Stevenson entrances. In the western Inlet, tidal currents were only half this magnitude, and in Shelikof Strait they were very small due to the presence of an antinode near the mooring in northern Shelikof Strait. Tidal currents were aligned with the local channel bathymetry. (Author) W86-00149

SOURCES, COMPOSITION, AND TRANS-PORT OF SUSPENDED PARTICULATE MATTER IN LOWER COOK INLET AND NORTHWESTERN SHELIKOF STRAIT,

Field 2—WATER CYCLE

Group 2L—Estuaries

National Oceanic and Atmospheric Administra-tion, Seattle, WA. Pacific Marine Environmental Lab.

For primary bibliographic entry see Field 2J. W86-00150

SUSPENDED PARTICULATE MATTER IN EL-LIOTT BAY, National Oceanic and Atmospheric Administra-tion, Seattle, WA. Pacific Marine Environmental

For primary bibliographic entry see Field 2J. W86-00151

ATCHAFALAYA RIVER DELTA; REPORT 9: WIND CLIMATOLOGY, Coastal Engineering Research Center, Vicksburg, MS.

M.S. Ebersole.
Technical Report HL-82-15, January 1985. Report 9 of a Series. 122 p, 57 Fig, 44 Tab, 6 Ref.

Descriptors: *Climatology, *Hydrodynamics, *Wind, *Weather patterns, *Bays, Wind velocity, Meteorological data collection, Seasonal variation, Model studies, Statistical analysis, Weather data

Data on the wind climate typical of the Atchafa-laya Bay area were gathered from October 1981 to October 1982. These data along with data from National Weather Service stations were statistically analyzed to give estimates of wind speed and direction. These statistics were then related to the different kinds of weather patterns that affect this region by categorizing these patterns into seven all-inclusive types with each defined by a particular set of dynamical characteristics. Data was provided on the frequency of occurrence of wind conditions both with and without regard to their causative factors. The latter results were used to substantiate results obtained using the statisticalclimatological approach. The long-term historical data gave information on extreme wind conditions that can be expected to occur in any given year. This data can be used to better understand physical I his data can be used to better understand physical processes within the bay that are strongly dependent on local wind conditions such as hydrodynamic circulation patterns, flooding and drying of marshes, dispersion and disposition of sediments, dispersion of any pollutants, and distribution of fresh and salt water.

W86-00163

CURRENT MEASUREMENTS IN THE CO-LUMBIA RIVER ESTUARY, Chalmers Univ. of Technology, Goeteborg (Sweden). Institutionen foer Kaernkemi. M. R. Mulhern. Master of Science, Report. University of Washing-ton, Seattle. 1982. 60 p, 10 Fig, 2 Tab, 16 Ref, 1

Descriptors: *Water currents, *Computer programs, Tidal currents, Estuaries, Current meters, Columbia River.

The principal product of this study was the development and analysis of contour plots of mean phase difference and velocity ratios, at the Columphase difference and velocity ratios, at the Columbia River entrance. Surface and subsurface currents were monitored by drifter buoys and subsurface current meters respectively in September 1981. Analog plots of the field data were scanned visually, and smoothed to eliminate high-frequency noise. A computer data base was produced consistent flow information sorted by current meter taining flow information sorted by current meter depth, and type of event (slack, flood or ebb). A series of computer programs were written to process the data and generate composite views of mean phase difference and velocity ratios, as compared to predicted tidal currents.

W86-00181

NORFOLK HARBOR AND CHANNELS DEEP-ENING STUDY, REPORT 1: PHYSICAL MODEL RESULTS, CHESAPEAKE BAY HY-DRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station,

Vicksburg, MS. Hydraulics Lab. D. R. Richards, and M. R. Morton. Technical Report HL-83-13, June 1983. Final Report. 371 p, 29 Fig, 14 Tab, 236 Plates, 9 Ref.

Descriptors: *Estuaries, *Saline water intrus *Channel improvement, *Water currents, *T effects, Shallow water, Salinity currents, Naviga-tion, Model studies, Hydraulic models, Norfolk Harbor, Chesapeake Bay, Tidal currents, Neap tides, Spring tides, Stratification, Harbors.

A physical model was use to study the impact of deepening the approach channels to Norfolk and Newport News, Virginia, in the Chesapeake Bay. Steady-state tests were designed to determine the tide and current velocity effects. The dynamic tests were used to study salinity redistribution. The salinity study showed the following: neap-spring variations (as great as 5-8 ppt) in salinity stratification, an increase in salinity intrusion normally confined to deep water areas (shallow water only slightly affected), redistribution of salt within the cross section of channels with adjacent shallow water (salinity increase in channel and decrease in shallow water), and net increase in depth-averaged salt with an increase in stratification. On the average, changes in salinity were less than 2 ppt. W86-00266

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

HIGH-TEMPERATURE DESALINATION CA-PABILITY OF TFC 1501 REVERSE OSMOSIS

ELEMENT, Army Mobility Equipment Research and Develop-ment Command, Fort Belvoir, VA. H. H. Goto.

Available from the National Technical Information Service, Springfield, VA 22161 as AD1A121059. Report 2367, July 1982. 36 p, 7 Fig, 4 Tab,

Descriptors: *Desalination apparatus, *Reverse os-Membrane processes, Water treatment,

The desalination capability of spiral-wound thin-The desalination capability of spiral-wound thin-film composite reverse osmosis elements (TFC 1501) was determined at temperatures up to 132 F, higher than the 113 F specified by the manufactur-er. The elements were not degraded in desalinizing capability following exposure for 400 hours to feedwater at about 130 F. The production rate of the elements dropped less than 5% under the fol-lowing conditions: 400 hours at 130 F and 200 hours at 130 F and high pressure (600 lb serge in) lowing conditions: 400 hours at 130 F and 200 hours at 130 F and high pressure (600 lb per sq in). The drop in production rate can be compensated for by operation at higher pressure, 1000 lb per sq in. Some telescoping of the elements occurred during high-temperature operation, but performance characteristics were not degraded. W86-00265

3B. Water Yield Improvement

RAINWATER CATCHMENT WATER QUAL-

TTY IN MICRONESIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
T. A. Dillaha, III, and W. J. Zolan.
Water Research, Vol. 19, No. 6, p 741-746, 1985. 1
Fig. 3 Tab, 18 Ref.

Descriptors: *Rainwater catchment systems, *Domestic water, *Micronesia, *Water quality, Bacteria, Cisterns, Potable water, Water supply, Coli-

Rainwater catchment systems (RWCS) in Micronesia were sampled to assess their bacteriological water quality and to determine which RWCS characteristics had a significant impact on water quality. Total and fecal coliform bacteria tests were

used to evaluate 203 catchments on 10 islands. Fifty-seven percent of the RWCS had no fecal coliform bacteria and 61% had fewer than 10 total coliform bacteria per 100 ml. Catchment characteristics were found to have a statistically significant effect on total coliform bacteria levels but they did not affect fecal coliform bacteria concentrations. Rainwater catchment systems were found to provide acceptable water in most cases but disinfection prior to consumption is still highly recommended. (Author's abstract) W86-00061

CLOUD PHYSICS STUDIES IN THE SCPP: IN-**TERIM PROGRESS REPORT, 1983-84**

Wyoming Univ., Laramie. Dept. of Atmospheric December 29, 1984. 123 p. Contract/Grant No. 2-

Descriptors: *Precipitation, *Weather modifica-tion, *Cloud seeding, Cloud physics, Orographic precipitation, Sierra Cooperative Pilot Project, Ice.

Several articles report some of the scientific contributions to the Sierra Cooperative Pilot Project. The shallow orographic cloud which remains on the Sierra barrier following passage of upper level hyperbaroclinic zones and katabatic fronts usually contains a substantial amount of supercooled water. The seedability of this cloud will be investigated. In a seeding experiment with dry ice, seeding effects were observed. Combined hydrometeor distributions from three PMS probes were described. In the ice multiplication region centered at scribed. In the ice multiplication region centered at -5 degrees C, the combined data are superexponential distributed so that they fit a straight line on a log-log plot. The remaining articles are reprints of referred articles and conference papers.

STRUCTURE OF COLD FRONTS OVER CALI-

Wyoming Univ., Laramie. Dept. of Atmospheric Science.

J. D. Marwitz.

In: Cloud Physics Studies in the SCPP: Interim Progress Report, 1983-84, December 29, 1984. p 1-28, 8 Fig, 12 Ref.

Descriptors: *Precipitation, *Weather modifica-tion, *Cloud seeding, Cloud physics, Katabatic frontal theory, California, Fronts, Sierra Nevadas.

The structure of cold fronts as they move over the Sierra barrier of California are described. The structure of the katabatic front on February 12, 1983, is presented including the kinematic structure as revealed by the serial rawinsondes at Sheridan, California, and the precipitation process as revealed by King Air cloud physics data. These katabatic fronts may represent significant seeding sectorics. otential

RESPONSES TO SEEDING CLOUDS WITH DRY ICE IN THE SCPP-1 EXPERIMENT.

Wyoming Univ., Laramie. Dept. of Atmospheric Science.

In: Cloud Physics Studies in the SCPP: Interim Progress Report, 1983-84, December 29, 1984. p 29-52, 14 Fig, 1 Ref.

Descriptors: *Weather modification, *Precipita-tion, *Cloud seeding, Orographic precipitation, Cloud physics, Sierra Cooperative Pilot Project,

Three case studies of treatment of convective clouds were presented. The two cases on March 15, 1984, were probably unseeded. This conclusion is based on the overwhelming body of physical evidence in which no seeding signature was found. The proximity of the seeding to natural echoes (even downwind of them) was not intentional in these cases. The lack of growth of the second cloud was probably the result of the presence of

WATER QUANTITY MANAGEMENT AND CONTROL-Field 4

Control Of Water On The Surface—Group 4A

these large natural cells. The two clouds, studied within the three-hour experiment, were very different in properties as indicated by the response variables presented. The first cloud, while having more initial ice present, persisted longer and had a much larger quantity of precipitation at 18 min than the second cloud. Both clouds, however, were clearly not in the formation region upwind of naturally occurring echoes as prescribed in the design document. The intentional seeding of the large convective cell on February 24, 1984, while producing a microphysical seeding signature, demonstrates the problems. producing a microphysical seeding signature, dem-onstrates the problems which are introduced by seeding convective clouds in proximity of other echoes. While this did not show that the cloud was echoes. While this did not show that the cloud was not seedable, at no time did the seeded region reach the reflectivities equivalent to the natural echoes on nearby storms. In the future, more vigilance is required on the part of both the aircraft and radar crews to avoid such anomalies. The results of these three analyses are evidence that the technology for seeding and studying single convective clouds is established. (Author)

3D. Conservation In Domestic and **Municipal Use**

MUNICIPAL WATER DEMANDS, Johns Hopkins Univ., Baltimore, MD. Dept. of Applied Economics.
For primary bibliographic entry see Field 6D.
W86-00275

3E. Conservation In Industry

Operational Economics, Inc., Houston, TX. For primary bibliographic entry see Field 6D. W86-00273 INDUSTRIAL WATER DEMANDS,

3F. Conservation In Agriculture

SEDIMENT TRANSPORT BY IRRIGATION RETURN FLOWS IN FOUR SMALL DRAINS
WITHIN THE DID-18 DRAINAGE OF THE
SULPHUR CREEK BASIN, YAKIMA COUNTY,
WASHINGTON, APRIL 1979 TO OCTOBER 1981, Geological Survey, Tacoma, WA. Water Re-

For primary bibliographic entry see Field 2J. W86-00112

AGRICULTURAL WATER DEMANDS, For primary bibliographic entry see Field 6D. W86-00274

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ADVANCEMENT IN HYDRAULIC MODEL-ING OF POROUS PAVEMENT FACILITIES, Espey, Huston and Associates, Inc., Austin, TX. For primary bibliographic entry see Field 2E. W36-00098

PLANNING AND IMPLEMENTATION OF RE-GIONAL STORMWATER MANAGEMENT FA-CILITIES IN MONTGOMERY COUNTY, MARYLAND,

MARYLAND, Greenhorne and O'Mara, Inc., Riverdale, MD. J. M. Crouse, V. H. Berg, and L. J. Mitchell. In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 255-271, 3 Fig. 4 Tab.

Descriptors: *Watershed management, *Model studies, *Runoff, *Storm runoff, *Erosion control, *Land development, *Urbanization, *Water quality management, Land use, Urban watersheds, Models, Sedimentation, Stream degradation, Storm water, Urban runoff, Detention reservoirs.

Increased flooding, accelerated channel erosion, Increased flooding, accelerated channel erosion, and reduced water quality of streams in Montgomery County, Maryland due to urbanization and land development has led to the enactment of legislation requiring sediment control during land development. In 1971 the Montgomery Soil Conservation District (MSCD) adopted a stormwater management (SWM) policy requiring the detention of stormwater runoff from the 2-yr storm event on each development site. In 1973 control was managed. of stormwater runoff from the 2-yr storm event on each development site. In 1973 control was mandated by the County's Department of Environmental Protection on a watershed basis. The remedial focus of the County SWM program includes projects to correct existing problems caused by uncontrolled runoff from previously developed areas as well as preventive programs to study the effects of proposed land use plans and their effects on stormflow throughout the watershed. In 1980 a stormwater management ordinance was enacted stormwater management ordinance was enacted which relies heavily on the use of centralized SWM facilities which may serve a number of de-velopments. The Cabin Branch study represents velopments. The Cabin Branch study represents one of several case studies being conducted by the County to assess the effects of SWM on subwatersheds. Computerized hydrologic modeling was used to project peak discharges for various development and land use scenarios. Results of these studies indicate that three SWM facilities should be designed and constructed in the Cabin Branch Watershed at specific sites. Watershed at specific sites. W86-00099

TIME-OF-TRAVEL DATA FOR NEBRASKA STREAMS, 1968 TO 1977, Geological Survey, Lincoln, NE. Water Resources

For primary bibliographic entry see Field 2E. W86-00120

IMPROVING TECHNOLOGY FOR CHEMICAL CONTROL OF AQUATIC PLANTS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. K. K. Steward.

Miscellaneous Paper A-82-4, August 1982. Annual Report for FY 1980. Army Engineer Waterways Experiment Station, Vicksburg, MS. 51 p, 13 Fig, 15 Tab, 8 Ref, Append.

Descriptors: *Aquatic weed control, *Herbicides, *Weed control, 2,4-D, Water hyacinth, Hydrilla, Watermilfoil, Duckweed, Southern naiad, Fenac, Dichlobenil, Pesticides, Cabomba, Water lettuce,

Several chemical aquatic weed control techniques were evaluated using a newly developed standard protocol. The release of 2,4-D from the MOE/GMA copolymer (2-methacryloyloxyethyl 2,4-dichlorophenoxyacetate glycerylmethacrylate) in flowing water following an initial application rate of 0.01 to 0.25 mg per liter was linear over 70 days. The compound was effectively phytotoxic to Eurasian watermilfoil for about 4 mo. A dichlobenil-besswax controlled-released system produced asian watermitton for about 4 mo. A cincitoeni-beeswax controlled-released system produced rapid and inconsistent release of the herbicide. Two of three controlled-release fenac formulations were effective against hydrilla at 1.0 mg per liter in 10 wk and against Southern naiad at 1.0 mg per liter in about 8 wk. Cabomba was not controlled. liter in about 8 wk. Cabomba was not controlled. Eurasian watermilfoil was controlled in 16 wk at 0.5 mg per liter. A coded compound (R0-3-7042) was effective against hydrilla over 16 wk at 1.0 mg per liter treatment rate and against Southern naiad in about 8 wk at 5.0 mg per liter. It was very effective against water leituce at 1.0 mg per liter; marginally effective against water hyacinth; and ineffective against duckweed and cabomba. A growth retardant (EL-507) controlled water hyacinth at 1.0 kg per hectare. W86-00183

PROCEEDINGS, 16TH ANNUAL MEETING, AQUATIC PLANT CONTROL RESEARCH PLANNING AND OPERATIONS REVIEW.

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.

November 17-19, 1981, St. Paul, Minnesota. Miscellaneous Paper A-82-3, June 1982. Final Report.

Descriptors: *Weed control, *Aquatic weeds, *Biocontrol, *Herbicides, Aquatic plants, Water hyacinth, Watermilfoil, Hydrilla, Insects, Aquatic insects, Lake Conway, Florida, Fish, White amur, Grass carp, Ecological effects, 2,4-D, Pesticides, Model studies, Fate of pollutants, Wildlife, Parapoynx, Sameodes, Microorganisms, Pathogens, Dredging, HARVEST model, Mechanical control.

Mechanical, chemical, and biological control of aquatic weeds is included in this collection of aquatic weeds is included in this collection of research papers and weed control activities in re-gional districts of the Army Engineers. The Limnos mechanical harvesting system improved vertical water mixing and did not significantly decrease dissolved oxygen levels after harvest. The HARVEST mathematical model proved useful in evaluating effects of equipment and environmental conditions on harvesting. Chemical control methconditions on harvesting. Chemical control methods included controlled-release 2,4-D formulations, structural investigation of a naturally occurring hydrilla inhibitor, and the fate of 2,4-D in water, sediment, and fish. Several biological controls proved potentially effective as weed control agents: Parapoynx (an aquatic moth), Sameodes albiguitalis, a variety of insects collected on overseas trips, and microorganisms. A method for surveying aquatic plants on a large scale was demonstrated in the Galveston, Texas, district. Applicastrated in the Galveston, Texas, district. Applica-tion of endothall to watermilfoil and hydrilla proved most effective in spring. Large-scale oper-ations management of aquatic weeds with white amur was studied in Lake Conway, Florida. The fish population controlled aquatic vegetation with-out major detrimental effects on native vertebrates or invertebrates. However, desirable vegetation was also sets. The diver operated deeder proved was also eaten. The diver-operated dredge proved efficient for removing small populations of water-milfoil with little fragmentation. W86-00192

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM PLANTS: SELECT-ED LIFE HISTORY INFORMATION OF ANIMAL SPECIES ON LAKE CONWAY, FL, Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. N. J. Zittleman, R. R. Williams, and E. G.

Buglewicz.

Miscellaneous Paper A-82-5, August 1982. Final Report. 101 p, 16 Ref, 3 Append.

Descriptors: *Lakes, *Weed control, *Baseline studies, *Habitats, *Animals, Aquatic animals, Lake Conway, Florida, White amur, Grass carp, Fish, Aquatic weeds, Aquatic habitats, Birds, Fish, Mammals, Amphibians, Reptiles, Food habits, Nesting, Ecology, Biocontrol, Environmental effects, Fish management.

A baseline study of the animal species in Lake Conway, Florida, lists 180 species sighted or collected during January 1976 through September 1977. This is an early activity in the large-scale management test to document the effects of the introduction of the white amur fish for controlling aquatic weeds. Appendix A is a species list with scientific names for 35 fish, 54 birds, 7 mammals, and 28 herpetofauna. Appendix B describes the life history and managment information for each of the species. Appendix C concerns feeding, resting, and reproduction or nesting habitat requirements for the animals. In this list appear several categories with the numbers of the species fitting the category. For example, under food preferences of herpetofauna, 20 types of food are listed with the animal species that use each type. species that use each type. W86-00197

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A-Control Of Water On The Surface

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS: THE HERPETOFAUNA OF LAKE CONWAY, SPECIES ACCOUNTS,

University of South Florida, Tampa. Dept. of Biol-

For primary bibliographic entry see Field 6G. W86-00202

2.4-D THRESHOLD CONCENTRATIONS FOR CONTROL OF EURASIAN WATERMILFOIL AND SAGO PONDWEED.

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. J. F. Hall, H. E. Westerdahl, R. E. Hoeppel, and

I. Williams Technical Report A-82-6, December 1982. Final Report. 20 p, 6 Fig, 3 Tab, 12 Ref.

Descriptors: *Weed control, *Aquatic weed control, *Herbicides, Aquatic plants, 2,4-D, Macrophytes, Watermilfoil, Pondweed, Diluter system.

The objective of this study was to use a modified diluter system to determine the minimum sustained (threshold) concentrations of 2,4-dichlorophenoxy (threshold) concentrations of 2,4-dichlorophenoxy acetic acid (2,4-D) required to control the growth of Eurasian watermilfoil (Myriophyllum spicatum L.) and Sago pondweed (Potamogeton pectinatus L.). This study was designed to incorporate recommended improvements and to verify results from a previous pilot study. The diluter system delivered five different concentrations of 2,4-D to five sets of four test aquaria. Another set of four reference course is received only tap water. Each aquarium four test aquaria. Another set of four reference aquaria received only tap water. Each aquarium contained meristematic cuttings of M. spicatum and germinated tubers of P. pectinatus planted in beakers containing a standard hydrosoil. Plant injury was assessed after 11 weeks of continuous exposure to the various 2,4-D concentrations. Based on the results of this study, the 2,4-D threshold concentrations required to control M. spicatum and P. pectinatus were determined to be 0.05 to and P. pectinatus were determined to be 0.05 to 0.10 mg per liter and 0.10 to 0.25 mg per liter, respectively. This coincided with previous results obtained from a 6-week pilot study. (Author) W86-00208

MISSION BAY HARBOR, CALIFORNIA, DESIGN FOR WAVE AND SURGE PROTECTION AND FLOOD CONTROL: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 8B. W86-00255

4B. Groundwater Management

USES OF RECHARGE WELLS IN WATER SUPPLY,

Keuringsinstituut voor Waterleidingartikelen, Rijs-wijk (Netherlands). J. H. Peters.

Journal of the American Water Works Association, Vol. 77, No. 5, p 47-51, 16 Fig, 16 Ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Water supply development, *Wells, Infiltration, Recharge wells, Groundwater flow, Computer models

Recharge wells, wells by means of which a liquid can be put into the ground have many applications in the field of water supply. Recharge wells can be used for compensating locally for the drawdown of the water table or groundwater head, for regulating the flow of contaminated or salt groundwater. er, for limiting the catchment and protection zone of a groundwater pumping station and in the technique known as artificial recharge. With a system of recharge and pumping wells it is possible to reduce fluctuations in water quality. Hydrological aspects of three applications of recharge wells were studied using imaginary models, and computer models used to study the flow of groundwater were examined. The potential of recharge wells is not confined to the alternative they offer to open infiltration. Infiltrating pretreated surface water into the ground limits the impact of groundwater withdrawal on the environment and of the environment on groundwater withdrawal. (Baker-IVI) W86-00006

WATER RESOURCES ON THE PUEBLO OF LAGUNA, WEST-CENTRAL NEW MEXICO, Geological Survey, Albuquerque, NM. Water Resources Div.

For primary bibliographic entry see Field 2F. W86-00108

GROUND-WATER RESOURCES OF AUDRAIN COUNTY, MISSOURI, Geological Survey, Rolla, MO. Water Resources

Div.

For primary bibliographic entry see Field 2F. W86-00113

GROUND-WATER CONDITIONS IN THE COTTONWOOD-WEST OAKLEY FAN AREA, SOUTH-CENTRAL IDAHO,

Geological Survey, Boise, ID. Water Resources

For primary bibliographic entry see Field 2F. W86-00117

AVAILABILITY OF WATER FROM THE AL-LUVIAL AQUIFER IN PART OF THE GREEN RIVER VALLEY, KING COUNTY, WASHING-

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00126

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.
Geological Survey, Bismarck, ND. Water Re-

For primary bibliographic entry see Field 7C. W86-00129 sources Div.

4C. Effects On Water Of Man's Non-Water Activities

HISTORICAL CHANGES TO LAKE WASHING-TON AND ROUTE OF THE LAKE WASHING-TON SHIP CANAL, KING COUNTY, WASH-

INGTON, Geological Survey, Seattle, WA. Water Resources

For primary bibliographic entry see Field 2H. W86-00105

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, 1978-JULY, 1981: CITATIONS FROM THE NTIS DATA BASE

National Technical Information Service, Spring-

National Technical Information of Technical Information Service, Springfield, VA 22161 as PB83-801357. December 1982. 271 p.

Descriptors: *Bibliographies, *Oil shale, *Industrial wastes, *Mine wastes, *Wastewater treatment, *Water pollution control, *Water quality control, Gasification, Pollutant identification, Leachates, Shales, Environmental effects, Ecological effects, Groundwater pollution, Streams, Aquifers, Water requirement.

This bibliography contains 366 abstracts of government-funded research on oil shale. Among the water-related subjects are water pollution control, waste and wastewater characterization and treatwaste and wastewater characterization and tream-ment, leachates, effect on groundwater and stream-water quality, health hazards, revegetation of dis-turbed soils, groundwater monitoring, environmen-tal and ecological impacts, geochemistry, social and economic impacts, hydraulic fracturing, hydrologic aspects, and water consumption.

4D. Watershed Protection

EVALUATION OF A HYDROGRAPH SHIFT-ING METHOD FOR ESTIMATING SUSPEND-ED-SEDIMENT LOADS IN ILLINOIS

Geological Survey, Urbana, IL. Water Resources

For primary bibliographic entry see Field 2J. W86-00115

EVALUATION OF HYDROLOGIC PROCESS-ES AFFECTING SOIL MOVEMENT IN THE HAGERMAN FAUNA AREA, HAGERMAN,

Geological Survey, Boise, ID. Water Resources

For primary bibliographic entry see Field 2G. W86-00119

BUHNE POINT, HUMBOLDT BAY, CALIFORNIA, DESIGN FOR THE PREVENTION OF SHORELINE EROSION: HYDRAULIC AND NUMERICAL MODEL INVESTIGATIONS, Coastal Engineering Research Center, Vicksburg, MS

MS. R. R. Bottin, and J. A. Earickson. Technical Report CERC-84-5, November 1984. Final Report. 336 p. 14 Fig. 17 Tab, 142 Photos, 78 Plates, 26 Ref, 2 Append.

Descriptors: *Model studies, *Erosion control, *Beach erosion, *Structural models, *Hydraulic models, Channel erosion, Design criteria, Models, Numerical analysis, Jetties, Sediment transport,

Two numerical and two physical models were used to study the effects of proposed improvement plans to rectify shoreline erosion at Buhne Point, Humboldt Bay. The numerical tidal circulation model showed that changes in tidal current velocities and flow patterns will be minimal due to proposed improvements. The numerical sediment transport model (CELC3D) showed that no new sediment transport model (CELC3D) showed that no new sediment transport model (CELC3D) showed that no new transport model (CELC3D) showed that no new sediment transport patterns are induced by the optimum improvement plan. The 1:100-scale physi-cal model of central Humboldt Bay showed that, regardless of the incident wave approach from the Pacific Ocean, the angle of the wave front in the vicinity of Buhne Point remains essentially the same. This same model also indicated that test waves directly up the axis of the channel result in significantly larger wave heights in the vicinity of waves directly up the axis of the channel result in significantly larger wave heights in the vicinity of Buhne Point. The 1:50-scale physical model of Buhne Point was used to determine the cause of erosion at the point and the effectiveness of the various structures proposed for protection. Results showed that wave energy approaching the point from the jettied entrance to the bay eroded the original spit. Sediment eroded from the eastern part of the shoal and migrated westwardly where it entered the navigation channel. A reverse curve in the shore-connected breakwater where it originates from the existing Buhne Drive revetment (optimum plan) minimized wave convergence and runup in this area.

W86-00169

ANSWERS (AREAL NONPOINT SOURCE WATERSHED ENVIRONMENT RESPONSE SIMULATION) USER'S MANUAL.

Purdue Univ., Lafayette, IN. Dept. of Agricultural

Purdue Univ., Latayette, IN. Dept. of Agricultural Engineering.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-115436.

EPA-905/9-82-001, December 1981. Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office. 54 p, 16 Fig. 3 Tab, 26 Ref. 4 Append. Contract/Grant No. EPA-G005335.

Descriptors: *Fate of pollutants, *Erosion control, *Soil conservation, *Model studies, *Watershed

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants-Group 5A

management, *Nonpoint pollution sources, Agri-cultural watersheds, Mathematical models, AN-SWERS model, Sediment transport, Hydrology, Land use, Sedimentation, Rainfall rate, Infiltration,

This report is an expanded and edited version of the Users Manual for the ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) model, first published in September, 1980. ANSWERS is a distributed parameter model capable of predicting the hydrologic and erosion response of primarily agricultural watersheds. Particle-size distributions of the eroded sediment (at all points in the watershed, as well as the outlet) are available. The manual provides insights into model concepts, input requirements, output interpretation, and planning applications. (Author) W86-00287

5. WATER QUALITY MANAGEMENT AND **PROTECTION**

5A. Identification Of Pollutants

ANALYSIS OF PHENOLS BY CHEMICAL DERIVATIZATION, IV. RAPID AND SENSITIVE METHOD FOR ANALYSIS OF 21 CHLOROPHENOLS BY IMPROVED CHLOROCACETYLATION PROCEDURE, Canada Centre for Inland Waters, Burlington (On-

Journal of the Association of Official Analytical Chemists, Vol. 68, No. 3, p 422-426, 1985. 3 Fig. 2

Descriptors: *Phenols, *Chlorophenols, *Chloroacetylation, *Water analysis, Chloracetic anhydride, Chemical analysis, Organic compounds, Gas chromatography, Chlorinated hydrocarbons.

matography, Chlorinated hydrocarbons.

A quantitative, rapid, sensitive, and isomer-specific method for the analysis of chlorophenols in natural water by in situ chloroacetylation was developed. Without pre-extraction, phenols in water are chloroacetylated by chloroacetic anhydride in the presence of K2CO3. Because of differences in reaction kinetics and stability, various chloroacetates were removed from the reaction mixture at different intervals. A more elaborate procedure was developed for cases where analysis of other classes of neutral organic compounds is also required; the procedure involves solvent extraction of organic compounds and back-extraction of phenols into K2CO3 solution followed by chloroacetylation. When a 12 m OV-1 fused silica capillary column was used, 22 phenol chloroacetates were easily resolved in a single run. Using distilled and natural water samples, this method has been validated and shown to be applicable over a concentration range of 0.1 to 100 micro-g/L of the phenols studied. (Author's abstract) W86-00002

MULTIRESIDUE METHOD FOR THE ANALY-SIS AND VERIFICATION OF SEVERAL HER-

SIS AND VERIFICATION OF SEVERAL HER-BICIDES IN WATER, Department of Agriculture, Regina (Saskatche-wan). Research Station. A. J. Cessna, R. Grover, L. A. Kerr, and M. L. Aldred. Journal of Agricultural and Food Chemistry, Vol. 33, No. 3, p 504-507, 1985. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Pesticide residues, *Herbicides, *Chemical analysis, *Detection limits, Water analysis, 2,4-D, Bromoxynil, Dicamba, MCPA, Picloram, Triallate, Trifluralin, Gas chromatogra-

Because of the diversity of herbicide products available, environmental water aamples would best be analyzed for herbicide residues by using a multresidue procedure. A multiresidue analytical method to determine and verify residues of both neutral and acidic herbicides in water was developed. Acidic herbicides were derivatized by using

diazomethane. Recoveries of herbicides (bromoxynil, 2,4-D, dicamba, MCPA, picloram, triallate, and trifluralin) from distilled water at fortification levels of 0.1-1 ppb ranged from 80 to 117%. Except for MCPA, all other herbicide residues could be verified by using two different detector modes. The method was used in a preliminary study to monitor herbicide residues in irrigation return flow waters at the Outlook Irrigation District (Saskatchewan). The supply water from the pumping station, monitored to provide background interferences for the various herbicides, consistently showed trace interferences at the retention time ly showed trace interferences at the retention time for 2,4-D which were less than the limit of detecly showed trace interferences at the retention time for 2,4-D which were less than the limit of detection. For the first two weeks of sampling, these interferences in the return flow water samples from the drainage ditches reflected what was found in the supply water. The average background interference in the 2,4-D region of the chromatogram was 0.13 ppb whereas those for the dicamba and bromoxynil regions were less than 0.1 ppb in both the supply water and in drainage ditch water prior to the commencement of spraying which occurred after the June 4 sampling; these backgrounds still permitted a limit of detection of 0.5 ppb for all three herbicides. The background interferences in the trifluralin and triallate regions readily permitted a limit of detection of 0.1 ppb. The method showed good reproducibility between duplicate water samples and these residues could be readily confirmed by using a specific gas chromatographic detector (the Hall detector in the halogen mode). (Collier-IVI)
W86-00046 W86-00046

RAPIDITY OF RNA SYNTHESIS IN HUMAN CELLS; A HIGHLY SENSITIVE PARAMETER FOR WATER CYTOTOXICITY EVALUATION, Service de Controle des Eaux de la Ville de Paris

(France).

C. Fauris, C. Danglot, and R. Vilagines. Water Research, Vol. 19, No. 6, p 677-684, 1985. 5 Fig, 3 Tab, 25 Ref.

Descriptors: *RNA synthesis, *Cytotoxicity testing, *Toxicity testing, *Water pollution effects, *Seine river, *Marne river, *Oise river, *France, Water analysis, Enzymes, Cell physiology, Animal physiology, Animal metabolism.

Effects of several water pollutants were tested, without any concentration, on the main cellular metabolic pathways of cultured human cells. The cellular targets studied were divided into four groups: the microsome and cytosol enzymes group (alkaline phosphatase, uridine kinase, thymidine kinase and ATPase); the mitochondrial enzymes group (ATPase and cytochrome oxidase); the iso-lated nuclei group (1 function); and the viable cells group (cytoplasmic membrane permeability and protein, RNA, and DNA synthesis). Each enzymatic activity or cellular function was tested in the presence of increasing concentrations of potassium dichromate, potassium cyanide, phenol, actinomycin D, sodium dodecyl sulfate, Triton X-100, and cupric sulfate. This comparison clearly indicated that the rapidity of cellular RNA synthesis was the most aensitive target to many pollutants. When that the rapidity of cellular RNA synthesis was the most sensitive target to many pollutants. When used in the water field this quantitative test does not require preliminary concentration of the water's toxic compounds and, in the case of polluted river waters, requires sample dilution. Response of the test is fast enough to require only a 2 h incubation for highly cytotoxic samples and 20 h incubation for samples of low cytotoxicity. Its simplicity makes it easily adaptable to routine analysis and continuous monitoring of any water. Weekly cytotoxicity determinations were performed for two months on the river Seine at different sampling points around Paris (France) and on formed for two months on the river Seine at different sampling points around Paris (France) and on the river Marne and the river Oise. Chemical and physical tests were performed on the samples awell. The classification obtained by the whole of physicochemical analysis correlated well with the cytotoxicity testing. The application domain of the test is very large, ranging from surface and ground waters to drinking and bottled mineral waters. (Collier-IVI) waters to dr (Collier-IVI)

TRACER APPLICATIONS OF ULTRA-VIOLET ABSORPTION MEASUREMENTS IN COAST-

University Coll. of North Wales, Menai Bridge. Marine Science Labs. For primary bibliographic entry see Field 2L. W86-00056

ESTIMATION OF PHOSPHORUS FLUX IN A REGULATED CHANNEL,
Inland Waters Directorate, Vancouver (British Co-

lumbia). Water Quality Branch. L. J. Zeman, and H. O. Slaymaker.

Water Research, Vol. 19, No. 6, p 757-762, 1985. 3 Fig. 19 Ref.

Descriptors: *Phosphorus flux, *Okanagan River, *British Columbia, *Regulated flow, Nutrients, Annual distribution, Water sampling, Sampling strategy, Nutrient flux, Load distribution.

During a nutrient loading study in the Okanagan River Basin, British Columbia, the regression relationship between phosphorus concentrations and the Okanagan River discharge was shown to be not statistically significant. Phosphorus flux could, therefore, not be determined by conventional methods which rely on the concentration-discharge relationship. The reason for failure of conventional methods is the regulated nature of the Okanagan River flow. Two sampling strategies for chemical analysis of water samples were applied: Oraniagan Aver inow. I wo sampling strategies for chemical analysis of water samples were applied:

(a) simultaneous, based on manual collection of sample replicates; and (b) sequential, using an automatic device to obtain a series of point concentration measurements. These sampling strategies provided a basis for nutrient flux estimation by the following methods; (a) partial load method, resulting from simultaneous sampling; and (b) flow interval method, based on sequential sampling. Load estimates and their confidence limits derived from the partial load method were compared with loads obtained by the flow interval method. There was a high lavel of correlation between the load some high level of correlation between the load estimgn level of correlation between the load esti-mates. Annual trends are more appropriately inves-tigated by the flow interval method, cross-sectional load variability and confidence limits should be assessed by the partial load method. (Author's ab-W86-00062

ASSESSMENT OF HEAVY METALS AND PCB'S AT SELECTED SLUDGE APPLICATION SITES IN ONTARIO, Department of the Environment, Ottawa (Ontar-

M. D. Webber, H. D. Monteith, and G. M. Corneau.

Environment Canada, Canada-Ontario's Agreement on Great Lakes Water Quality, Research Report No. 109, 1981. 27 p, 2 Fig, 10 Tab, 16 Ref.

Descriptors: "Fate of pollutants, "Bioaccumulation, "Sludge disposal, "Sludge utilization, "Grain crops, "Heavy metals, "Polychlorinated biphenyls. "Plant tissues, Path of pollutants, Land disposal, Metals, Cadmium, Zinc, Waste disposal, Molybdenum, Corn, Wheat, Oats, Ruminants, Solid waste disposal.

Ten aludge application sites were sampled during the summers of 1976 and 1978 for PCB and metal concentrations in soil and plants. Determinations of PCB and metal loadings showed that metal loadings exceeded the maxima recommended in the Ontario Sludge Utilization Guidelines at several sites. Sludge application increased the total metal and PCB contents and the DTPA-extractable metals in the soils. The largest increases generally coincided with the largest estimated loadings. The coincided with the largest estimated loadings. The effects of sludge application on plants were minimal, except for an increase of Cd and Zn contents in plant materials. Stratford sludge contributed a heavy Mo loading and greatly increased the Mo content of corn leaves at that site. An exclusive diet of corn leaves from the Stratford site would cause Mo-induced Cu deficiency in ruminant animals. Increased Zn concentrations in plants would be desirable because Zn is usually deficient in plant and animal nutrition. However, increased Cd animal nutrition. However, increased Cd

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A-Identification Of Pollutants

levels are undesirable because of the metal's toxicity to both plants and animals. Sludge application to land according to the Ontario Guidelines will not cause deleterious uptake of heavy metals by corn, oats and wheat.

W86-00102

WATER-QUALITY APPRAISAL, MAMMOTH CREEK AND HOT CREEK, MONO COUNTY, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div. J. G. Setmire.

Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4060, 1984. 50 p, 15 Fig, 15 Tab, 6 Ref.

Descriptors: *Eutrophication, Dissolved oxygen, *Algal growth, *Mineralization, Nitrates, *Sedi-mentation, *Bacteria, *California, Mammoth Creek, Hot Creek, Mono County, *Mammoth

A late summer reconnaissance in 1981 and a spring high-flow sampling in 1982 of Mammoth Creek and Hot Creek, located in the Mammoth crest area of the Sierra Nevada, indicated that mineralization, eutrophication, sedimentation, and limited areas of fecal contamination were occurring. Mineralizaeutrophication, sedimentation, and limited areas of fecal contamination were occurring. Mineralization, indicated by a downstream increase in dissolved-solids concentration, was due primarily to geothermal springs that gradually decreased in the percentage of calcium, increased in the percentage of magnesium and sodium, and caused fluctuating, but overall increasing percentage of fluoride, sulfate, and chloride. Resulting water quality in Mammoth Creek was similar to that of the springs forming Hot Creek. Eutrophication was observed in Twin Lakes and the reach of Hot Creek below the fish hatchery. Twin Lakes had floating mats of algae and a high dissolved-oxygen saturation of 147 percent at a pH of 9.2. Hot Creek had excessive aquatic vascular plant and algae growth, dissolved-oxygen saturations ranging from 65 to 200 percent, algal growth potential of 30 milligrams per liter, and nitrates and phosphates of 0.44 and 0.157 milligrams per liter, sedimentation was noted in observations of bed-material composition showing the presence of fine material beginning at Sherwin Creek Road. Fecal contamination was indicated by fecal coliform counts of 250 colonies per 100 ed by fecal coliform counts of 250 colonies per 100 milliliters and fecal streptococcal counts greater than 1,000 colonies per 100 milliliters. (USGS)

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF THE MOUNT SIMON-HINCKLEY AQUIFER, SOUTHEAST

Geological Survey, St. Paul, MN. Water Resources Div. For primary bibliographic entry see Field 2K. W86-00109

QUALITY OF WATER, QUILLAYUTE RIVER BASIN, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div. For primary bibliographic entry see Field 2K. W86-00111

INVESTIGATION OF WAIKELE WELL NO. 2401-01, OAHU, HAWAII: PUMPING TEST, WELL LOGS AND WATER QUALITY, Geological Survey, Honolulu, HI. Water Resources Div. sources Div.

For primary bibliographic entry see Field 2K. W86-00118

ASSESSMENT OF WATER RESOURCES IN LEAD-ZINC MINED AREAS IN CHEROKEE COUNTY, KANSAS, AND ADJACENT AREAS, Geological Survey, Lawrence, KS. Water Resources Div.

T. B. Spruill.

Available from the OFSS, USGS, Box 25425,
Lakewood, CO 80225. USGS Open-File Report

84-439, (1984). 102 p, 23 Fig, 26 Tab, 35 Ref.

Descriptors: *Mine drainage, *Groundwater contamination, *Stream pollution, *Groundwater hydrology, Water quality, *Water quantity, *Kansas, Cherokee, Lead and zinc mines.

A study was conducted to evaluate water-resource problems related to abandoned lead and zinc mines in Cherokee County, and adjacent areas in Oklahoma and Missouri. Discontinuities and perforations, which were produced by mining in the confining shale west of the Pennsylvanian-Missispipian geologic contact, have created artificial groundwater recharge and discharge areas. Abandoned wells and drill holes present the greatest contamination hazard to water supplies in the deep aquifer. There is a potential for downward movement from the shallow to the deep aquifer throughout the study area, with greatest potential in Ottawa County, Oklahoma. Principal effects of abandoned mines on groundwater quality are lowered pH and increased concentrations of sulfate and trace metals of water in the mines. No conclusive evidence of lateral migration of contaminated mine water from the mines into the water-supply wells adjacent to the migration of contaminated mile water from the mines into the water-supply wells adjacent to the mines was found. Analyses of water from the deep aquifer did not indicate trace-metal contamination. The effects of abandoned mines on streamwater quality are most severe in Short Creek and Tar Creek. Increased concentrations of zinc and manganese were observed in the Spring River below Short Creek Kansas. (USGS) W86-00121

TREND ANALYSIS OF SALT LOAD AND EVALUATION OF THE FREQUENCY OF WATER-QUALITY MEASUREMENTS FOR THE GUNISON, THE COLORADO, AND THE DOLORES RIVERS IN COLORADO AND ITEMA.

Geological Survey, Lakewood, CO. Water Resources Div. For primary bibliographic entry see Field 5B. W86-00123

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.
Geological Survey, Bismarck, ND. Water Re-

For primary bibliographic entry see Field 7C. W86-00129

CHEMISTRY FOR OPERATORS, Muskegon County Board, MI. Dept. of Public For primary bibliographic entry see Field 5F. W86-00134

LABORATORY PROTOCOLS FOR EVALUATING THE FATE OF ORGANIC CHEMICALS IN AIR AND WATER,

AIR AND WATER, SRI International, Menlo Park, CA. T. Mill, W. R. Mabey, D. C. Bomberger, T.-W. Chou, and D. G. Hendry. EPA-600/3-82-022, July 1982. Environmental Re-search Laboratory, Athens, GA. 329 p, 21 Fig, 46 Tab, 287 Ref. Contract/Grant No. 68-03-2227.

Descriptors: *Fate of pollutants, *Testing procedures, *Air pollution, *Water pollution, *Organic compounds, Biotransformation, Oxidation, Aquatic habitats, Hydrolysis, Photolysis, Sorption.

Laboratory test procedures (or protocols) have Laboratory test procedures (or protocols) have been developed to provide data useful in evaluating the environmental fate of organic compounds in natural aquatic systems and in the atmosphere. Screening-level protocols are described to estimate rate constants for hydrolysis, photolysis, oxidation, biotransformation, volatilization processes in natural aquatic systems, and a screening protocol for measurement of partition coefficients for sorption of organic chemicals to sediments is also described. Detailed test protocols have been developed for hessurentania of organic chemicals to sediments is also described of organic chemicals to sediments is also described the hydrolysis, photolysis, volatilization, and sediment-sorption processes to obtain more accurate and precise data for use in environmental assess-

ments applied to aquatic systems. Screening and detailed test protocols are described for estimating rate constants for the atmospheric photolysis and oxidation of organic compounds. For each process, the theory and the present state of knowledge regarding the environment are reviewed, and some common methods currently in use are critically evaluated. (Author) W86-00154

MICROBIOLOGICAL WATER QUALITY OF IMPOUNDMENTS: A LITERATURE REVIEW, Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
G. A. Burton.

Micallaguer, Paper B 93.6 December 1092. Final

G. A. Burton.

Miscellaneous Paper E-82-6, December 1982. Final
Report. U.S. Army Environmental and Water
Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 53 p,
5 Tab, 210 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Literature review, *Sampling, *Water quality, *Reservoirs, *Microbiologial studies, *Bacterial analysis, Water sampling, Indicators, Bioindicators, Coliforms, Public health, Diseases, Pathogens, Parasites, Viruses.

gens, Parasites, Viruses.

Assessing the microbiological water quality of impoundments and the potential for waterborne disease outbreaks is a difficult task when using traditional sampling programs. Problems associated with using fecal coliform bacteria as indicators of human pathogen presence complicates assessments of future water quality in preimpoundment areas. Reliable determination of future and present microbiological water quality requires knowledge of how the chemical, physical, and biological characteristics of the watershed and impoundment interrelate to influence microbial indicator and pathogen densities. Accurate estimates of microbial indicator and pathogen densities, obtainable by using the enumeration methods and their modifications suggested in this report, will allow monitoring of the proper indicator organisms and estimation of potential sites of pathogen occurrence, density, and survival. Sampling programs must be geared toward critical time periods and areas; i.e., summer months, storm flows, feeder streams, agricultural and urban runoff, and swimming areas, including water and sediments. Frequency of sampling should be dictated by variability of water conditions, confidence level of data, and extent of human contact. Choice of proper indicator organisms and enumeration methods and appropriate sampling strategies will allow sound preimpoundment assessment and reservoir management to greatly reduce the risk of waterborne disease outbreaks. (Author) ment assessment and reservoir management to greatly reduce the risk of waterborne disease out-breaks. (Author)

PROCEDURES FOR HANDLING AND CHEMICAL ANALYSIS OF SEDIMENT AND WATER SAMPLES.

State Univ. of New York Coll. at Buffalo. Great R. H. Plumb

R. H. Fluttlo.
Technical Report EPA/CA-81-1, May 1981. Army Engineer Waterways Experiment Station, Vicksburg, MS. 482 p, 52 Fig, 32 Tab, 44 Ref. Contract/Grant No. EPA-4805572010.

Descriptors: *Pollutant identification, *Chemical analysis, *Sediments, *Sampling, *Water analysis, Sample preparation, Sample preservation, Bottom sampling, Dredging, Organic compounds, Cation exchange capacity, Particle size, Hydrogen ion concentration, Oxidation-reduction potential, Inorganic compounds, Carbon, Metals, Nitrogen compounds, Ammonia, Phosphates, Sulfides, Carbamates, Chlorinated hydrocarbons, Oil, Pesticides, Insecticides, Herbicides, Pherbicides, Pher

This handbook provides guidance for sampling, preservation, and analysis of dredged and fill material. Its emphasis is on regulatory affairs rather than research. Section 1 shows a project manager

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution—Group 5B

the trade-offs involved in developing a sampling program. Factors which must be considered are program. Factors which must be considered are sampling locations, sampling equipment, number of samples, types of tests, and specific chemical analyses. Section 2 shows laboratory and field personnel how to implement the sampling program. This includes the sample equipment and handling as well as the three general chemical tests: standard elutriate test, bulk analysis, and sediment fractionation. Section 3 gives details of analytical techniques for 44 parameters, including physical analysis (cation exchange capacity, particle size, pH, oxidation reduction potential, total and volatile solids, specific gravity), inorganic analysis (carbon, metals, nitrogen and compounds, phosphates, sulfides), organic analysis (carbamates, herbicides, insecticides, oil/grease, phenolics), chlorine demand, biochemical oxygen demand, chemical oxygen demand, and sediment oxygen demand. W86-00198

MICROCOMPUTER ASSISTED QUALITY AS-

Lotic Enterprises, Bakersfield, CA. 1984, 106 p.

criptors: *Pollutant identification. Descriptors: *Pollutant identification, *Wastewater treatment, *Water analysis, *Computer programs, *Quality control, *Statistical methods, Bacterial analysis, Chemical analysis, Physical analysis, Sampling, Standards, Standard deviation, Correlation analysis, Equations, Error analysis, Precision, Detention time, Corrosion, Larson/Langlier saturation index, Saturation index, Metric system, Mathematical studies.

Computer programs written in BASIC are given for quality assurance programs in water analysis and wastewater treatment laboratories. Each computer program includes a program description, documentation which the user must enter, the definition of variables, an example, a run, and a listing of the program. Some of the programs are organization of samples, typical report forms, internal standard method, standard addition (for determining low levels of the analyte), standard deviation, control charts, linear correlation ocefficient, equation of the straight line, linear regression, linear interpolation from a single point, atomic absorption detection limits, percent recovery, mean error accuracy, anion-cation balance, feed rates, detention times, corrosive tendency, Larson/Langelier saturation index, and metric unit conversion.

METHODS FOR ECOLOGICAL TOXICOLOGY: A CRITICAL REVIEW OF LABORATORY MULTISPECIES TESTS. Oak Ridge National Lab., TN. Environmental Sciences Div.

For primary bibliographic entry see Field 5C. W86-00210

MONITORING MARINE MICROBIAL FOUL-

National Aeronautics and Space Administration, Huntsville, AL. George C. Marshall Space Flight

Center.
Technical Support Package, MFS-25928, Spring 1984. 23 p, 1 Tab.

Descriptors: *Pollutant identification, *Microorganisms, *Fouling, *Bacterial analysis, *Microbiological studies, Microscopy, Films.

A method for monitoring biofouling on metal surfaces and nylon parachute material immersed in seawater was developed. It involves a combination of scanning electron microscopy and isolation, enumeration, and identification of biofouling microorganisms, using standard microbiological culture methods. Marine biofouling increases with length of exposure of the water and with water temperature. The polysulfide sealant and nylon parachute material were more readily biofouled than metallic surfaces. Spray washing was not effective for removing deposits of organic biofilm. W86-00227 W86-00227

SAMPLING FREQUENCY - MICROBIOLOGI-CAL DRINKING WATER REGULATIONS: FINAL REPORT, Drexel Univ., Philadelphia, PA. Dept. of Biologi-

Drexel Univ., Philadelphia, PA. Dept. of Biological Sciences.

W. O. Pipes, and R. R. Christian.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-127738.

EPA/570/9-82-001, September 1982. Environmental Protection Agency, Washington, DC. Office of Drinking Water. 174 p, 22 Fig, 70 Tab, 25 Ref, Append.

Descriptors: *Pollutant identification, *Water analysis. *Water distribution, *Sampling, *Bacteria, Coliforms, Microorganisms, Monitoring, Microbiological studies.

A sampling model was developed to specify the sampling frequency needed to determine compli-ance with the microbiological maximum contami-nant levels of the Natinal Interim Primary Drinkance with the micropiological maximum comannant levels of the Natinal Interim Primary Drinking Water Regulations. Two approaches were used: empirical, based on fitting coliform data to frequency distributions; and mechanistic, done by analyzing the physical elements of the system to determine the distribution of coliforms throughout a water system. In the empirical approach the truncated lognormal distribution was chosen. In this case coliform densities < 1/100 ml or > 80/100 ml cannot be measured. The probability of violation is a function of the densities of coliforms, the number of samples collected, and the parameters of the lognormal distribution. Therefore a higher degree of aggregation of coliform bacteria leads to larger numbers of samples being needed for detection of contamination. The mechanistic approach showed that the water distribution system could be divided into hydraulically isolated sections. It was concluded that all sections must be ctions. It was concluded that all sections must be sections. It was concluded that all sections must be included in the monitoring program to get an accurate measure of coliform occurrence. Coliform occurrence did not differ between peripheral and nonperipheral locations or with distance from the water source. Thus sampling locations for a micro-biological monitoring program can be selected on a randomized basis. a randomize W86-00245

ADDENDUM TO HANDBOOK FOR SAM-PLING AND SAMPLE PRESERVATION. Environmental Monitoring and Support Lab.-Cin-EPA-600/4-83-039, August 1983, 28 p, 3 Tab.

Descriptors: *Water analysis, *Pollutant identifica-tion, *Sampling, *Water sampling, *Sample prepa-ration, *Monitoring, Sample preservation, Preser-vation, Monitoring, Water analysis.

This addendum has an updated and expanded Table 2.3, listing automatic samplers and their characteristics. In addition, the definitions of contracteristics. In addition, the definitions of sample types (discrete, composite, flow proportional composite, hand proportioned composite, and continuous composite) have been revised. Additional references on samplers and sampling are listed.

W86-00268

SAMPLING AND DETECTION OF TAGGED DREDGED MATERIAL, Argonne National Lab., IL. Energy and Environmental Systems Div. L. S. Van Loon, D. L. McCown, and J. D.

Ditmars.

Available from the National Technical Information Service, Springfield, VA 22161 as DE82016056.

ANL/EES-TM-169, January 1982, 29 p, 17 Fig, 5 Ref. Contract/Grant No. W-31-109-Eng-38.

Descriptors: *Pollutant identification, *Dredging, *Sediment transport, Sand, Sampling, Ultraviolet radiation, Fluorescence.

Systems for sampling and detecting tagged dredged sand in the Upper Mississippi River were develped by Argonne National Laboratory for the U.S. Army Corps of Engineers, Rock Island District. The Corps plans to demonstrate main-channel disposal of dredged material, and it requires

systems to detect the movement of the dredged material after the material has been placed in a deep reach of river. The dredged material in the demonstration will be tagged with sand particles coated with fluorescent dye. Argonne designed systems for sampling of the bottom surficial sediments at discrete points along transects from a boat that employs a precision navigation system; on-board visual inspection of the samples for dyed sand in an ultraviolet light box; and photography of ultraviolet-illuminated samples. This report describes the systems and their uses as well as the results of tests to determine proper settings for photographic equipment. (Author) W86-00288 systems to detect the movement of the dredged

5B. Sources Of Pollution

AVERAGE RAINWATER PH, CONCEPTS OF ATMOSPHERIC ACIDITY, AND BUFFERING IN OPEN SYSTEMS, Texas Univ. at Austin. Dept. of Environmental

alth Engineering. H. M. Liljestrand.

Atmospheric Environment, Vol. 19, No. 3, p 487-499, 1985. 4 Fig, 2 Tab, 24 Ref, 2 Append. EPA grant R810148-01 and California Air Resources Board grant A7-110-30.

Descriptors: *Acid rain, *Chemistry of precipta-tion, *Hydrogen ion concentration, *Chemical re-actions, *Buffering, Carbon dioxide, Ammonia, Hydrochloric acid, Nitrates, Sulfur dioxide, Car-bonate, Air pollution.

The system of water equilibrated with a constant partial pressure of CO2, as a reference point for pH acidity-alkalinity relationships, has nonvolatile acidity and alkalinity components as conservative quantities, but not H(+) concentration. Simple algorithms were developed for the determination of the average pH for combinations of samples both above and below pH 5.6. Averaging the nonconservative quantity H(+) concentration yields erroneously low mean pH values. To extend the open CO2 system to include other volatile atmospheric acids and bases distributed among the gas. liquid acids and bases distributed among the gas, liquid and particulate matter phases, a theoretical frame-work for atmospheric acidity was developed. Within certain oxidation-reduction limitations, the total atmospheric acidity (but not free acidity) is a conservative quantity. The concept of atmospheric conservative quantity. The concept of atmospheric acidity was applied to air-water systems approximating aerosols, fogwater, cloudwater and rainwater. The buffer intensity in hydrometeors is a function of net strong acidity, partial pressures of acid and base gases and the water to air ratio. For high liquid to air volume ratios, the equilibrium partial pressures of trace acid and base gases are set by the pH or net acidity controlled by the nonvolatile acid and base concentrations. For low water to air volume ratios as well as stationary state systems such as precipitation scavenging with continuous emissions, the partial pressures of trace gases (NH3, HCl, HNO3, SO2 and CH3COOH) appear to be of greater or equal importance as carbonate species as buffers in the aqueous phase. (Author's abstract) W36-00001

CHLORINATED ORGANICS IN SIMULATED GROUNDWATER ENVIRONMENTS, Florida International Univ., Miami. Drinking Water Research Center.

Water Research Center.
F. Parsons, and G. B. Lage.
Journal of the American Water Works Association, Vol. 77, No. 5, p 52-59, May, 1985. 9 Fig. 7
Tab, 27 Ref.

Descriptors: *Chlorinated hydrocarbons, *Groundwater, *Biotransformation, *Degradation, Biodegradation, Fate of pollutants, Trichloroethane, Tetrachloromethane, Trichlormethane, Dich-

Tetrachloromethane and 1,1,1-trichloroethane were transformed in microcosms composed of aquifer materials to trichloromethane and 1,1-dichloroethane, respectively. Further observations of triand tetrachloroethane in microcosms demonstrated

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

the transformation of these compounds to dichlor-oethane. Biotransformation products of these four solvents by freshwater sediment microbiota, in sealed static microcosms, were determined by gas sealed static microcosms, were determined by gas chromatography during incubation at ambient tem-peratures in the dark for periods of up to 16 weeks. Under conditions of neutral to acid pH, reductive potential, and the absence of oxygen and light, reductive dehalogenation of these four compounds occurred. Chlorinated alkenes were comsistently more resistant to biotransformation than the chlor-inated alkanes. (Author's abstract)

AWWA SURVEY OF INORGANIC CONTAMINANTS IN WATER SUPPLIES. For primary bibliographic entry see Field 5F. W86-00009

SURFACE BUOYANT JETS IN STEADY AND REVERSING CROSSFLOWS, Worcester Polytechnic Inst., Holden, MA. Alden Research Labs. D. N. Brocard.

Journal of Hydraulic Engineering, Vol. 111, No. 5, p 793-809, May, 1985. 10 Fig, 2 Tab, 19 Ref.

Descriptors: *Buoyant jets, *Crossflows, *Plumes, *Heated water, Path of pollutants, Buoyant spreading, Boundary effects, Water currents.

Data on suface buoyant jets in steady and reversing crossflows was obtained with experiments conducted in a 130 ft (40 m) by 81 ft (25 m) by 1.5 ft (0.45 m) deep basin, which was large enough to ensure negligible boundary effects while allowing controlled ambient conditions. The test results are presented nondimensionally and referenced to controlling length scales. The steady crossflow results are trajectories and longitudinal temperatures, which show the effects of the discharge buoyancy and initial flow rate. Comparing these results with those of other experimental studies leads to the suspicion that boundary effects may be present in some of the latter. The reversing crossflow tests furnish surface temperature patterns and plume depths for a range of conditions. These results can be used to evaluate mathematical models. In addition, the effects of tidal reversal on the offshore extent and depth of the plume are examined. Dis-Data on suface buoyant jets in steady and reverstion, the effects of tidal reversal on the orisnore extent and depth of the plume are examined. Dispersion tests reveal that buoyancy played an important role in plume spreading. This factor is important as buoyant spreading is frequently omitted in two dimensional farfield mathematical models of thermal plumes. (Author's abstract)

DISPERSION IN ANISOTROPIC, HOMOGE-NEOUS, POROUS MEDIA, Baghdad Univ. (Iraq). Coll. of Engineering. For primary bibliographic entry see Field 2F. W86-0015

INITIAL DILUTION FOR OUTFALL PARAL-LEL TO CURRENT, Monash Univ., Clayton (Australia). Dept. of Me-

Monash Univ., Clayton (Australia). Dept. of Mechanical Engineering.
J. B. Hinwood, and I. G. Wallis.
Journal of Hydraulic Engineering, Vol. 111, No. 5, ps 828-845, May, 1985. 7 Fig. 2 Tab, 10 Ref, 2 Append. Australian National Energy Research Development and Demonstration Council grant 78/2799.

Descriptors: *Outfalls, *Dilution, *Currents, *Diffusers, Thermal pollution, Wastewater outfall, Plumes, Buoyancy.

Rotary tidal currents or site constraints can result Rotary total currents of site constraints can result in an outfall diffuser being alined with the current in shallow water. Experiments using a small model laboratory diffuser flume and a much larger scale model in an estuarine channel were used to establish the significant processes causing initial dilution of effluent discharged from a multiport diffuser alined parallel to the ambient current. From conaiderations of momentum conservation and mixing, and the results of the flume experiments, an expression for the initial dilution in shallow water was

obtained the conditions defining shallow water were established. The results of the field experiments carried out in an estuarine channel were in agreement with the laboratory results and verified the derived expression. A relationship between the initial dilution and the angle between the diffuser and the current was developed from the field stud-ies. (Author's abstract) W86-00016

REGIONAL UNSTEADY INTERFACE BE-TWEEN FRESH WATER AND SALT WATER IN A CONFINED COASTAL AQUIFER, Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
For primary bibliographic entry see Field 2F.

FATE OF ALDICARB, ALDICARB SULFOX-IDE, AND ALDICARB SULFONE IN FLORI-DAN GROUNDWATER, Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences. C. J. Miles, and J. J. Delfino.

Journal of Agricultural and Food Chemistry, Vol. 33, No. 3, p 455-460, 1985. 4 Fig. 3 Tab, 28 Ref.

Descriptors: *Aldicarb, *Pesticides, *Florida, *Groundwater contamination, *Fate of pollutants, Chemical reactions, Degradation, Hydrolysis, Limestone, Biodegradation, Microcosms.

The fate of aldicarb, aldicarb sulfoxide, and aldicarb sulfone in Floridan groundwater microcosms carb sulfone in Floridan groundwater microcosms was determined. One reaction mechanism observed was base hydrolysis and degradation rates decreased in the order, sulfone > sulfoxide >> aldicarb. Appearance of oximes followed the disappearance of corresponding parent compounds while appearance of nitriles was minor and rarely observed. Microcosms amended with crushed limestone showed rates of hydrolysis that were 4-5 times slower than microcosms without limestone. Oxidation of aldicarb to the sulfoxide was minimal within 70 days whereas in separate experiments, within 70 days whereas in separate experiments, the reduction of the sulfoxide to aldicarb was significant over the same time period. The sorption of aldicarb, aldicarb sulfoxide, and aldicarb sulfone onto limestone was not observed. (Author's abstract) W86-00045

LABORATORY AND FIELD STUDIES ON THE

LABORATORY AND FIELD STUDIES ON THE FATE OF 1,3,6,8-TETRACHLORODIBENZO-P-DIOXIN IN SOIL AND SEDIMENTS, Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst. D. C. G. Muir, A. L. Yarechewski, R. L. Corbet, G. R. B. Webster, and A. E. Smith. Journal of Agricultural and Food Chemistry, Vol. 33, No. 3, p 518-523, 1985. 1 Fig, 6 Tab, 21 Ref.

Descriptors: *Dioxins, *Sediments, *Soil, *Fate of pollutants, Degradation products, Carbon radioisotopes, Isotope studies, Lake sediments.

The fate of C-14-ring-labeled 1,3,6,8-tetrachlorodibenzo-p-dioxin (TCDD) was studied in sandy loam soil under field conditions and in silty-clay pond and lake sediments under laboratory conditions. Dissipation of 1,3,6,8-TCDD from small field plots was relatively rapid with 44% of the applied radio-activity lost after 131 days post-treatment. In sediment, 80% of the radioactivity could still be accounted for as intact chemical after 675 days under static serobic conditions (10 and 25 C) or after 310 days under a nitrogen or air purge. Transformation static aerobic conditions (10 and 25°C) or after 310 days under a nitrogen or air purge. Transformation of 1,3,6,8-TCDD to degradation products and unextractable radioactivity in soils and sediments was very slow. Unidentified polar products represented a maximum of 2.5% of extractable C-14 in field soils and 7.0% in sediments. DDT incubated in sediments under the same conditions had half-lives of < 310 days. (Author's abstract)
W86-00047

HETEROTROPHIC SLIMES IN IRISH RIVERS, EVALUATION OF THE PROBLEM, Trinity Coll., Dublin (Ireland). Environmental Sci-

ences Unit. N. F. Gray, and C. A. Hunter. Water Research, Vol. 19, No. 6, p 685-691, 1985. 2 Fig. 10 Tab, 14 Ref.

Descriptors: *Slimes, *Fungus, *Heterotrophic slimes, *Ireland, *Rivers, Surveys, Water pollution effects, Fish kills, Odors.

A questionnaire survey was used to determine the frequency of occurrence, extent and duration of sime growth in Irish rivers. Other factors such as the source of slime-promoting effluents, the degree of treatment given to effluents prior to discharge of treatment given to effluents prior to discharge and the effects slime growth was having on water-courses were also examined. 156 outbreaks were recorded throughout Ireland which affected approx 350 km of channel. Discharges from the agricultural processing industry and domestic sewage were most frequently associated with slime outbreaks. Few of the outbreaks were insignificant in length with 33.7% in excess of 1 km and 13.5% in excess of 5 km. Although 12.6% of outbreaks resulted in no adverse effects on watercourses, major problems reported included the appearance and amenity value being adversely affected (86.4%), smell and deoxygenation (46.6%), damage to fish stocks (37.9%) and problems of sloughed flocs of slime (24.3%). The severity of these adverse effects was directly related to the length of outbreaks. The situation in Ireland was compared to England and Wales. (Author's abstract) stract) W86-00053

GROUNDWATER SEEPAGE NUTRIENT LOADING IN A FLORIDA LAKE, Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering. For primary bibliographic entry see Field 2H. W86-00065

RELEASE OF ENDOTHALL FROM AQUATHOL GRANULAR AQUATIC HERBI-CIDE, North Texas State Univ., Denton. Dept. of Biolog-For primary bibliographic entry see Field 5G. W86-00068

ALTERNATING DIRECTION GALERKIN TECHNIQUE FOR SIMULATION OF CON-TAMINANT TRANSPORT IN COMPLEX GROUNDWATER SYSTEMS,

GROUNDWATER SYSTEMS, Waterloo Univ. (Ontario). Dept. of Earth Sciences. A. D. Daus, and E. O. Frind. Water Resources Research Vol. 21, No. 5, p 653-664, May, 1985. 14 Fig. 2 Tab, 20 Ref. Natural Sciences and Research Council of Canada operat-

ing grant A8368.

Descriptors: *Contamination, *Path of pollutants *Solute transport, Finite element method, Computers, Simulation, Groundwater flow, Groundwater pollution.

A general contaminant transport simulation technique based on a Galerkin finite element representation in space and an alternating direction timestepping scheme is developed. The formulation, which is in terms of natural coordinates following stepping scheme is developed. The formulation, which is in terms of natural coordinates following the principal directions of hydraulic conductivity of the medium, decouples the spatial components of the equations, leading to tridiagonal matrices. The numerical accuracy can be easily controlled in each principal direction through the well-established Peclet and Courant numbers. The ADG2 technique showed excellent potential for application to a variety of groundwater contamination scenarios. Applied to an isotropic, homogeneous system, it possesses the same favorable performance characteristis as the PD method of Frind and Pinder. These include delivery of equal or better accuracy compared with the conventional two-dimensional finite element technique; control over numerical dispersion through the Peclet and Courant criteria; independence of the numerical accuracy on the element aspect ratio; and low operations count, low core storage requirements, and

Sources Of Pollution-Group 5B

low solution roundoff error. The ADG2 technique possesses some distinct advantages over the P method; a grid that is invariant in time; applicability to transient flow conditions; and an ability to handle anisotropic flow systems and complex stratigraphy. The ADG2 technique retains both the flexibility of the finite element method and the efficiency of the alternative direction technique. Because of its simple structure and the absence of large banded matrices, the algorithm could provide a base for more complex modes such as those combining geochemical reactions with advective-dispersive transport. (Baker-IVI) W86-00072

ANALYSIS AND INTERPRETATION OF SINGLE-WELL TRACER TESTS IN STRATIFIED AQUIFERS, Auburn Univ., AL. Dept. of Civil Engineering. For primary bibliographic entry see Field 2F. W86-00074

ONE-DIMENSIONAL ANALYTICAL SOLU-TIONS FOR THE MIGRATION OF A THREE-MEMBER RADIONUCLIDE DECAY CHAIN IN A MULTILAYERED GEOLOGIC MEDIUM, Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.

A. B. Gureghian, and G. Jansen.

Water Resources Research, Vol. 21, No. 5, p 733-742, May, 1985. 9 Fig, 3 Tab, 13 Ref, 2 Append.

Descriptors: *Path of pollutants, *Groundwater pollution, *Radioactive wastes, Transport, Waste disposal, Radionuclides, Laplace equation, Com-

The Laplace transform method was used to analytically solve the one-dimensional transport equation of a three-member decay chain in a stratified geologic medium. The solution for the nondispersive case is exact. The solution for the general case, although analytic in the first layer, takes a semianalytical form in the subsequent layers by virtue of its numerical integration requirements. Two types of boundary conditions are considered at the source, i.e., a continuous and a band release mode. The accuracy of the solutions was satisfactorily tested on a selected number of problems for which experimental and analytical solutions were available. The practical use of the solutions in a two-dimensional domain is illustrated by a scenario of radionuclide migration from a high level waste repository located in a saturated multilayered aquifer. The computational scheme was programmed in FORTRAN IV and executed on a CDC/CYBER-74-NOS-BE operating system. (Baker-IVI) W86-00081

SEDIMENT-WATER INTERFACE IN MODEL-ING PESTICIDES IN SEDIMENTATION

PONDS, Princeton Univ., NJ. Dept. of Civil Engineering. P. R. Jaffe, and R. A. Ferrara. In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 53-64, 6 Fig, 1 Tab, 4 Ref.

Descriptors: "Model studies, "Bottom sediments, "Sedimentation, "Pesticide kinetics, "Sediment transport, "Adsorption, "Fate of pollutants, "Sedi-mentation basins, Settling basins, Pesticides, Models, Simulation analysis, Partition coefficient, Particulate matter, Path of pollutants.

A model was developed to study what effect a sedimentation pond may have on the pesticide load carried via sediment transport to receiving waters. The water column of the pond is represented as a completely mixed system. To model this system, equations are required to describe the changes in volume, suspended sediments, adsorbed pesticide concentration, and pesticide concentration in the bottom sediments. Results of several simulations showed that the peak concentration of pesticides in the sedimentation pond is about 3% of the peak storm runoff concentration without a pond. If the partition coefficient is increased, the reduction of the

peak concentration is even higher, indicating the improved removal efficiency of the sedimentation process. If no decay occurs, the total yearly load to the receiving waters will be the same with or without a pond once final conditions occur (after a few seasons). If some decay occurs, the total yearly load at final conditions will be less with a

MIXING ZONE MODEL FOR CONSERVA-TIVE PARAMETERS, Oklahoma Water Resources Board, Oklahoma

For orimary bibliographic entry see Field 5G. W86-00089

SOME RECENT ADAPTATIONS AND APPLICATIONS OF QUAL-II IN THE NORTHEAST, W. W. Walker.

In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 87-101, 5 Fig. 1 Tab, 22 Fef.

Descriptors: *Computer models, Models, *Model studies, *Water quality, *Dissolved oxygen, *Nitrogen, *Phosphorus, *Nutrients, Waste load, Rivers, River basins, Simulation analysis, Phytoplankton, Ammonia, Algae.

The modifications of the QUAL-II model to improve simulations of dissolved oxygen conditions in rivers heavily impacted by photosynthesis are discussed along with recent applications of the model in New England. To improve simulations of phytoplankton, nutrients, and oxygen compartments were added for detrital organic P and organic N, algal uptake of ammonia and/or nitrate N, self-shading by phytoplankton, and specification of alternative nutrient limitation by N or P. The Vermont Agency of Environmental Conservation used the QUAL-II model during a wasteload allocation study on the Winooski River when assessing the possible requirements for advanced waste treatment. The Sebasticook River study examined the impacts of a combined municipal/industrial discharge on a small stream (upper east branch) which discharges into an inlet of Lake Sebasticook, a eutrophic Maine lake. The model was also applied to the Sudbury/Concord Rivers in Massachusetts as part of an assessment of the potential environmental constraints involved in diverting waters from the upper watershed for water supply purposes. Interfacing the model output with SAS and plotting routines facilitates calibration, testing, and statistical analysis of observed and predicted water quality profiles. The revised code can be used on microcomputers or mainframes with FOR-TRAN capability. The modifications of the QUAL-II model to im-

REVIEW OF MODEL USE IN EVALUATING NONPOINT SOURCE LOADS FROM FOREST MANAGEMENT ACTIVITIES, National Council of the Paper Industry for Air and Stream Improvement Inc., New York. G. G. Ice, and R. C. Whittemore. In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 102-122, 6 Fig. 7 Tab, 24 Ref.

Descriptors: *Forest management, *Forest water-sheds, Sediments, Erosion, *Nonpoint pollution sources, *Model studies, *Hydrologic models, *Water quality management, *Channel erosion, Water quality, *Soil erosion, Erosion, Landslides, Models, Prediction, Stream degradation.

There is currently an urgent need to validate models that predict water quality, streambed, and stream biota responses to forest practices due to the Clean Water Act and the diverse silvicultural nonpoint source (NPS) control programs developed under Section 208. In addition to regulatory requirements for the use of models, the forestry community has recently begun to consider the consequences of multiple forest operations on water quality. Models are needed to predict not

only changes in sediment concentration (the traditional NPS measure for forest practice impacts on water quality) but also changes in channel conditions and the beneficial uses of the water. In response to these demands, the EPA published 'An approach to Water Resources Evaluation of Non-point Silvicultural Sources' (WRENSS) in 1980. The sediment prediction components of WRENS include models for water quantity, surface erosion, landslides, and total potential sediment and channel modification. The National Council for Air and Stream Improvement (NCASI) has used WRENSS to predict baseline sediment yields from undisturbed basins. NCASI is collecting data from landslide surveys to evaluate predictive methods. The Siuslaw National Forest procedures predict a ianosine surveys to evaluate predictive methods. The Siuslaw National Forest procedures predict a number of forest-wide responses to various stresses. The areas where model development are needed are identified along with research programs that would enhance understanding of forest water quality metalling. lity modeling. W86-00091

MECHANISTIC SIMULATION FOR TRANSPORT OF NONPOINT SOURCE POLLUT-

Simons, Li and Associates, Inc., Fort Collins, CO. D. B. Simons, R.-M. Li, and K. G. Eggert. In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 146-160, 5 Fig, 13 Ref.

Descriptors: *Model studies, *Watershed manage-ment, *Erosion, *Simulation analysis, *Nonpoint pollution sources, *Fate of pollutants, *Path of pollutants, Watersheds, Nutrients, Organic matter, Dissolved solids, Pesticides, Sediments, Stream degradation, Bank erosion, Channel erosion.

A simulation model for evaluation of alternative management parameters is presented. The model may be used to predict watershed response to land use, including both planned and unplanned events. Nonpoint source pollution from these events may include loading of streams by sediment from erosion, thermal energy, biological contaminants, organic debris, nutrients and dissolved solids, pesticides, and other wastes in solution or adsorbed to sediments. The simulation consists of a soil-plantatmospheric water simulation for adjusting soil moisture as a function of evaporation, evapotranspiration, soil water hydraulics, and snowmelt, and a kinematic wave surface water routing compospiration, soil water hydraulics, and snowmelt, and a kinematic wave surface water routing component. Other model compartments predict hydraulically-based sediment yield, subsurface flow, temperature and dissolved oxygen, pollutant routing and streambank erosion and forest litter routing. This preliminary planning model should be useful in evaluating selected alternatives as a function of environmental goals. W86-00092

ASSESSMENT OF HEAVY METALS AND PCB'S AT SELECTED SLUDGE APPLICATION SITES IN ONTARIO,

Department of the Environment, Ottawa (Ontar-

ary bibliographic entry see Field 5A. W86-00102

NUTRIENT INPUT FROM THE LOXAHAT-CHEE RIVER ENVIRONMENTAL CONTROL DISTRICT SEWAGE-TREATMENT PLANT TO THE LOXAHATCHEE RIVER ESTUARY, SOUTHEASTERN FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.

W. H. Sonntag, and B. F. McPherson.

Available from the OFSS, USGS, Box 25425,
Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4020, 1984. 23 p, 3 Fig, 8
Tab, 4 Ref.

Descriptors: *Effluents, *Nutrients, Water quality, Loxahatchee River estuary, *Florida, *Estuaries, *Sewage effluents.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

Two test discharges of treated-sewage effluent were made to the Loxahatchee River in February and September 1981 from the ENCON sewage treatment plant to document nutrient loading and downstream transport of the effluent to the estuary under maximum daily discharge allowable by law (4 million gallons per day). Concentrations of total nitrogen in the effluent exceeded background concentrations by as much as 7 times during the February test, while concentrations of total phosphorus exceeded background concentrations by as rus exceeded background concentrations by as much as 112 times during the September test. The effluent was transported downstream to the estu-ary in less than 24 hours. Discharge of treated sewage effluent to the river-estuary system in the 1981 water year accounted for less than 0.5 percent of the total nitrogen and 8 percent of the total phosphorus discharged from the major tributaries phosphorus discharged from the major tributaries to the estuary. If maximum discharges of effluent (4 million gallons per day) were sustained throughout the year, annual nitrogen loading from the effluent would account for 5 to 18 percent of the total nitrogen input by the major tributaries to the estuary. With maximum discharges of effluent, annual phosphorus loading would exceed the amount of phosphorus input by the major tributaries to the estuary by 54 to 167 percent. (USGS) W86-00110

ASSESSMENT OF WATER RESOURCES IN LEAD-ZINC MINED AREAS IN CHEROKEE COUNTY, KANSAS, AND ADJACENT AREAS, Geological Survey, Lawrence, KS. Water Resources Div.

For primary bibliographic entry see Field 5A. W86-00121

DIGITAL SIMULATION OF THE REGIONAL EFFECTS OF SUBSURFACE INJECTION OF LIQUID WASTE NEAR PENSACOLA, FLORI-

DA, Geological Survey, Tallahassee, FL. Water Re-

Geological Survey, Fallaniassec, F.2. Walled Sources Div.
M.L. Merritt.
Available from the OFSS, USGS, Box 25425,
Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4042, 1984. 73 p. 19 Fig, 1

Descriptors: *Liquid wastes, *Injection, *Waste disposal, *Water pollution effects, *Hydraulic models, *Computer models, *Florida, Water pollution sources, Injection effects, Floridan aquifer.

Industrial, organic, liquid waste has been injected into a part of the lower limestone of the Floridan aquifer at one site since 1963 and at another site aquifer at one site since 1963 and at another site since 1975, raising water levels in the injection zone throughout a large region. The hydrogeologic conceptual model of the injection zone is a layer tightly confined above by a thick layer of clay and in which lateral hydraulic conductivity decreases rapidly below the upper 60 feet. Recharge areas are to the north and east, where the confining layer pinches out. There appear to be permeability barriers to the northwest, west, and southwest due to facies changes, faults, or pinchouts. Measured and reconstructed preinjection water levels suggested that flow in the aquifer is from the northern recharge areas toward the southeast. A steady-state model simulation incorporating the cited boundary assumptions approximately simulated this pattern. A two-dimensional flow model and the subsurface waste injection program (SWIP) were calibrated to simulate the water level increases at various monitor wells since program (SWIP) were calibrated to simulate the water level increases at various monitor wells since 1963. Sensitivity analyses showed the simulations to be quite sensitive to moderate errors in either transmissivity or storage parameter specifications. The predictive use of the hydraulic model is understood to be restricted to the geographical locations of data used for model calibration. (USGS) W86-00122

TREND ANALYSIS OF SALT LOAD AND EVALUATION OF THE FREQUENCY OF WATER-QUALITY MEASUREMENTS FOR THE GUNNISON, THE COLORADO, AND THE DOLORES RIVERS IN COLORADO AND

Geological Survey, Lakewood, CO. Water Resources Div.

J. E. Kircher, R. S. Dinicola, and R. F. Middelburg.

Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4048, 1984. 69 p, 20 Fig, 15 Tab, 16 Ref.

Descriptors: *Statistical methods, *Regression analysis, Network design, *Water-quality data, *Salinity, *Colorado, *Utah, Colorado River basin, *Trend analysis.

Monthly values were computed for water-quality constituents at four streamflow gaging stations in the Upper Colorado River basin for the determinaconstituents at four streamflow gaging stations in the Upper Colorado River basin for the determination of trends. Seasonal regression and seasonal Kendall trend analysis techniques were applied to two monthly data sets at each station site for four different time periods. A recently developed method for determining optimal water-discharge data-collection frequency was also applied to the monthly water-quality data. Trend analysis results varied with each monthly load computational method, period of record, and trend detection model used. No conclusions could be reached regarding which computational method was best to use in trend analysis. Time-period selection for analysis was found to be important with regard to intended use of the results. Seasonal Kendall procedures were found to be applicable to most data sets. Seasonal regression models were more difficult to apply and were sometimes of questionable validity; however, those results were more informative than seasonal Kendall results. The best model to use depends upon the characteristics of the data and the amount of trend information needed. The measurement-frequency optimization method had potential for application to water-quality data, but refinements are needed. (USGS)

PRELIMINARY APPRAISAL OF SEDIMENT SOURCES AND TRANSPORT IN KINGS BAY AND VICINITY, GEORGIA AND FLORIDA, Geological Survey, Doraville, GA. Water sources Div.

For primary bibliographic entry see Field 2J. W86-00125

RUNOFF, SEDIMENT TRANSPORT, AND WATER QUALITY IN A NORTHERN ILLI-NOIS AGRICULTURAL WATERSHED BEFORE URBAN DEVELOPMENT, 1979-81, Geological Survey, Urbana, IL. Water Resources

For primary bibliographic entry see Field 2J. W86-00133

COEFFICIENTS FOR USE IN THE U.S. ARMY CORPS OF ENGINEERS RESERVOIR MODEL, CE-QUAL-R1,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. C. D. Collins, and J. H. Wlosinski.

Technical Report E-83-15, October 1983. Final Report. 120 p, 39 Tab, 357 Ref.

Descriptors: *Data collections, *CE-QUAL-R1, *Computer programs, Algorithms, Reservoirs, Water quality, Respiration, Mortality, Decomposi-

This report supplies information about, and literature values for, many of the coefficients needed for the U.S. Army Corps of Engineers Reservoir Model, CE-QUAL-R1. Most of the information presented concerns biological processes of gross production, ingestion, respiration, mortality, and decomposition. Coefficients specified are suitable for the algorithms described in the Instruction Report E-82-1 entitled CE-QUAL-R1: A Numerical One-Dimensional Model of Reservoir Water Quality: User's Manual, available from the Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss. (Author) (Author) W86-00153

EFFECTS OF ACID RAIN ON SOIL AND

Connecticut Agricultural Experiment Station, New Haven. For primary bibliographic entry see Field 2K. W86-00166

POINT SOURCES-NONPOINT SOURCES TRADING IN THE LAKE DILLON WATER-

Northwest Colorado Council of Governments, Final Report, 1984. 45 p.

Descriptors: *Nonpoint pollution sources, *Point pollution sources, *Trading, *Algae growth, *Advanced wastewater treatment, *Water pollution sources, Phosphorus, Eutrophication, Lake Dillon.

Lake Dillon is a highly valued water supply and recreational resource in north-central Colorado. Changing land uses and development in the basin have produced near-eutrophic algae growth in the lake. All wastewater treatment plants currently employ advanced wastewater treatment for phosphares were all Evision 12 plants. employ advanced wastewater treatment for phosphorus removal. Even with zero phosphorus discharge from treatment plants in the future, non-point phosphorus sources from growth areas would make the lake eutrophic. A phosphorus control plan for the lake was developed by local governments and adopted by the Colorado Water Quality Control Commission. The plan recommended that advanced wastewater treatment continue to be applied to all point sources. State-of-times to be applied to all point sources. intended that advanced wastewater treatment con-tinue to be applied to all point sources. State-of-the-art nonpoint sources controls will be applied by local governments to all new development projects in the basin. An effluent trading system projects in the basin. An effluent trading system was developed to allow point sources growth beyond 1990. The trading system authorized by the State Commission allows dischargers to receive credit for cleaning up nonpoint sources which existed prior to 1984. A 2:1 ratio is used to account for uncertainties in the process. One pound of credit is assigned for each two pounds of preexisting nonpoint source phosphorus which is eliminated. This approach should keep phosphorus loading at 1982 levels. It allows local governments to control phosphorus in the most cost-effective manner without being limited only to further reductions on point sources. (Author) W86-00167

FATE OF CHEMICALLY DISPERSED OIL IN THE SEA: A REPORT ON TWO FIELD EXPERIMENTS,

New Jersey Dept. of Environmental Protection,

D. R. Green, J. Buckley, and B. Humphrey. EPS 4-EC-82-5, December 1982. Environmental Protection Service, Ottawa (Ontario). 125 p, 42 Fig. 16 Tab, 8 Plates, 10 Ref.

Descriptors: *Oil Slicks, *Dispersants, Seawater, Oil Spills, Corexist 9527, Biodegradation.

Oil Spills, Corexist 9527, Biodegradation.

Three liters of oil were spilled in each of two moored plastic enclosures (CEPEX enclosures) in Saanich Inlet, British Columbia. Corexit 9527 was used to disperse a portion of the surface slick in one enclosure while the other enclosure served as a control. The oil dispersion was stable during the two week period. The average droplet size was 1 micrometer or less. The dispersion of the oil resulted in a rate of biodegradation that is at least an order of magnitude higher than that for undispersed oil. Within 15 days, microbial oxidation of the alkane component of the oil was completed. Only 0.1% of the dispersed oil reached the sediments during the 15 day time period, and this oil was in an advanced state of bacterial decomposition. Loss of volatile components from dispersed oil was slower than from the surface slick. No detectable photochemical oxidation of the dispersed oil or the surface slick. Cocurred during the experiment. Three experimental oil spills of 200, persect off of the surface sinck occurred uning the experiment. Three experimental oil spills of 200, 400, and 200 liters were conducted in October 1978 at Royal Roads, British Columbia. The surface slicks were restrained with a Bennett inshore oil boom. The spilled oil was dispersed using Corexit 9527. The highest recorded concentration of dis-

Sources Of Pollution-Group 5B

persed oil was 1 ppm. After 30 min concentrations of 0.05 ppm were normal, decreasing to background within 5 hr. The dispersed oil did not mix deeper into the water column with time. The integrated quality of oil in the water column decreased more rapidly than either the mean oil concentration of the cloud or the maximum concentration. (Author's abstract, modified).

W86-00172 d oil was 1 ppm. After 30 min concentrations

CHARACTERIZATION OF AEROBIC CHEMI-CAL PROCESSES IN RESERVOIRS; PROB-LEM DESCRIPTION AND MODEL FORMU-

Camp, Dresser and McKee, Inc., Annandale, VA. R. L. Chen, D. Gunnison, and J. M. Brannon. Technical Report E-83-16, October 1983. Final Report. 87 p, 21 Fig, 9 Tab, 144 Ref.

Descriptors: *Mathematical models, *Dissolved oxygen, *Hydrologic models, *Rate models, Water quality control, Reservoirs, Stratification, Oxidation process, Aerobic conditions, Anaerobic condi-

This report discusses oxidation pathways of chemicals and important environmental parameters that affect the transformation rate of selected nutrients and metals in lakes and reservoirs, and presents a model for predicting the transition from anaerobic to aerobic conditions. In order to better demonstrate the second of the production model for predicting the transition from anaerobic to aerobic conditions. In order to better demonstrate the necessary components for an aerobic predictive model, consideration was given to the basic concepts of the most commonly available equilibrium models for predicting water quality in lakes. Evaluation of the practicality of available models revealed that, although equilibrium models provide the flexible and comprehensive approaches necessary for water quality prediction, rate models are more precise and reliable in their depiction of the transition from anoxic to aerobic conditions in reservoirs. Oxidation rates of selected nutrients and metals in U.S. Army Corps of Engineers reservoirs were determined in environmentally controlled laboratory investigations. Field measurements of the fate of reduced iron and manganese in the anoxic bottom water of Eau Galle Reservoir, Wisconsin, during destratification, corroborated the laboratory results. These oxidation rate coefficients will form the basic input variables for RE-AERS, a reaeration subroutine of the water quality evaluation model CE-QUAL-R1.

COMPUTER MODELING OF HYDRODYNA-MICS AND SOLUTE TRANSPORT IN CANALS AND MARINAS: LITERATURE REVIEW AND GUIDELINES FOR FUTURE DEVELOPMENT, National Board of Waters, Helsinki (Finlar

National Board of Waters, Helsinki (Finland).
R. Walton.
Miscellaneous Paper EL-83-5, September 1983.
Final Report U.S. Army Environmental Impact
Research Program, Army Engineer Waterways
Experiment Station, Vicksburg, MS. 94 p, 45 Fig.
108 Ref.

Descriptors: *Canals, *Marinas, *Hydrodynamics, *Computer models, *Solute transport, Mathematical models, Literature review, Design criteria, Water quality, Physical properties, Model studies,

A literature review of modeling the hydrodynamics and solute transport processes in tidal canals and marinas is presented. Tidal prism analysis and one- and multi-dimensional models are described. By considering the three areas of physical processes, modeling, and design criteria, it is concluded that much still needs to be learned to enable the engineer to design such systems to meet a rational that much still needs to be learned to enable the engineer to design such systems to meet a rational set of design criteria. In evaluating such proposed designs, the permitting agencies are in the same relative state of uncertainty as to what constitutes a 'good, environmentally acceptable' design. Future direction should include the selection of several varied existing canal and marina sites, and a program to study them to understand the fundamental physics and water quality processes involved. The next step should be to use this information to develop numerical models that can model the important processes observed, and a validation of

their formulation. These models should be developed as engineering, as well as scientific, tools to allow easy use by practicing design engineers. A program of selective model and measurement sen-sitivity should be performed. These criteria should make sense to both the design engineer and the permitting agencies. W86-00179

DISSOLVED METHANE CONCENTRATIONS IN THE SOUTHEAST BERING SEA, 1980 AND

1981, Science and Education Administration, Fort Lau-derdale, FL. Aquatic Plant Management Lab. For primary bibliographic entry see Field 2K. W86-00180

SORPTION BEHAVIOUR OF 14C IN GROUNDWATER/ROCK AND IN GROUND-WATER/CONCRETE ENVIRONMENTS, Seakem Oceanography Ltd., Sidney (British Columbia).

B. Allard, B. Torstenfelt, and K. Andersson. Report Prav 4.27, March 1981. 11 p, 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Fate of pollutants, *Water pollution prevention, *Radioactive wastes, *Carbon radioisotopes, *Sorption, Waste disposal, Underground waste disposal, Calcite, Concrete, Groundwater, Carbonates, Chemical precipitation, Moraine, Montmorillonite, Bentonite, Quartz, Granite,

Rocks.

The sorption of carbon-14, present in radioactive waste from powerplants and nuclear fuel waste treatment, was studied in batch and column experiments on several solids. Although sorption of C14 was generally low, it increased with increasing calcium content of the solid. The order of increasing sorption on the solids was as follows: granite, sodium montmorillonite, sandy moraine < clayish moraine < bentonite/quartz (10/90) < calcite < concrete, cement paste. Calcite and sandy moraine were the only materials permeable enough for column tests. In experiments with calcite, the retention factor was 3 (C14 transport was up to 3 times slower than water). Higher retention is expected at lower groundwater flow due to the slow kinetics of sorption on calcite. It is expected that the retention factor for concrete and bentonite/quartz would be high enough for use as backfill materials in a radioactive waste repository. No C14 would leak from intact concrete. Even fractured concrete would retain most of the C14 by precipitation of carbonate.

USER GUIDE FOR LARM2: A LONGITUDINAL-VERTICAL, TIME-VARYING HYDRODYNAMIC RESERVOIR MODEL,
Edinger (J.E.) Associates, Inc., Wayne, PA.
E. M. Buchak, and J. E. Edinger.
Instruction Report E-82-3, December 1982. Final
Report. U.S. Army Environmental and Water
Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 91 p,
4 Fig. 4 Ref. 9 Append. Contract/Grant No.
DACW39-78-C-0057.

Descriptors: "Fate of pollutants, "Lakes, "Reservoirs, "Water quality, "Model studies, Mathematical models, LARM2 model, Computer models, Hydrodynamics, Dillon Reservoir, Colorado.

LARM2 (laterally averaged reservoir model, version 2) has several improvements over the parent model, LARM. It incorporates a water quality transport module (WQTM) and the capability to add or delete upstream longitudinal segments during flooding or drawdown. This user's guide contains an overview of the model, a summary of its theoretical basis, a description of its application procedure, and an example, the Dillon Reservoir, Colorado. The appendixes include an input data description with examples and user notes for two auxiliary codes. LARM2 can be applied to a single, continuous reach of a river, lake, or reservoir. For \$300 computer time, this model can be used for an eight-month simulation at a time step of 15 min for

temperature and one other constituent on a grid that is 30 segments by 20 layers with 375 active cells. Estimates do not include intermediate simula-tions and postprocessing of results. W86-00190

HYDROCARBONS ASSOCIATED WITH SUS-PENDED MATTER IN THE GREEN RIVER,

WASHINGTON,
National Oceanic and Atmospheric Administra-tion, Seattle, WA. Pacific Marine Environmental

S.E. Hamilton, and J. D. Cline. NOAA Technical Memorandum ERL PMEL-30, May 1981. 116 p, 20 Fig. 18 Tab, 1 Ill, 62 Ref, 3

Descriptors: *Fate of pollutants, *Hydrocarbons, *Rivers, *Suspended solids, *Wastewater treatment, Effluents, Green-Duwamish River, Washington, Aromatic hydrocarbons, Aliphatic hydrocarbons, Vegetation, Outfall, Wastewater outfall, Sediments, Organic compounds.

The suspended hydrocarbon composition in the Green-Duwamish River was defined seasonally and spatially, with special interest in the discharges from the Renton Secondary Treatment Plant. Above Auburn, Washington, he hydrocarbon mixture is dominated by odd-carbon paraffins derived from aquatic and terrestrial plants. In December the C15 and C17 alkanes associated with algae were at the lowest levels of the year. At the sewage outfall the proportion of odd- to even-carbon hydrocarbons decreased, reflecting the increase in even-carbon n-alkanes, pristane, and phytane. Concentrations of total alphatics, total aromatics, and an unresolved complex mixture increased with distance downriver. A hydrocarbon budget calculated for the lower river showed that heavy hydrocarbons were preferentially lost below the sewage outfall. Possible causes for this are (1) floculation or desorption of suspended hydrocarbons as the effluent mixed with the river water and (2) incomplete recovery of material during analysts. bons as the effluent mixed with the river water and (2) incomplete recovery of material during analysis. Suspended matter in the river water contained these aromatics: retene, benz(e,pyrene, perylene, enz(e,h,i)perylene, chrysene, and fluoranthene at concentrations of 0.08-2.2 micrograms per gram dry weight. Levels of perylene and benz(g,h,i)perylene in the effluent were about 40 micrograms per gram. Esters of the even-carbon fatty acids associated with wastewater and higher plants were also found in these sediment samples. W86-00196

WORKING PAPERS PREPARED AS BACK-GROUND FOR TESTING FOR EFFECTS OF CHEMICALS ON ECOSYSTEMS,

National Research Council, Washington, DC. Committee to Review Methods for Ecotoxicology. For primary bibliographic entry see Field 5C. W86,00230

ECOTOXICOLOGY AT THE WATERSHED

LEVEL, Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab. L. A. Norris.

In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 137-148, 9 Ref.

Descriptors: *Ecotoxicology, *Fate of pollutants, *Water pollution effects, *Organic compounds, *Aquatic habitats, Lakes, *Ecosyatems, *Toxicology, Watersheds, *Environmental effects, Chemical properties, Heavy metals, Metals, Solubility, Vapor pressure, Stability.

Relatively few toxicological tests on the watershed Relatively few toxicological tests on the watershed (ecosystem) level have been done. Traditional techniques emphasize direct effects of chemicals on selected organisms. However, indirect effects are also important and may be far-reaching on the ecosystem level. For example, a chemical which reduces the primary productivity of an ecosystem may not directly affect organisms on higher troph-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B-Sources Of Pollution

ic levels, but the reduction in primary production may have an overwhelming effect. Other factors such as logging or tilling may interact with the chemicals of interest. Baseline values are necessary to determine the effects of natural processes such as carbon fixation by primary producers, energy transfers, nutrient cycling, and decomposition or organic substrates. Watershed pairing is desirable, but few are available for this purpose. Many factors affect the behavior of chemicals in the environment: properties of the chemical (water solubility, equilibrium vapor pressure, partition coefficient, and pH); and environmental properties (climatic, edaphic, topographic, and biotic). Chemicals of particular concern are heavy metals and substances with low water and high fat solubility, high equilibrium vapor pressure, high degree of stability, and high degree of mobility in soil.

UTILITY OF SINGLE SPECIES AND ECOSYSTEM TESTS IN ASSESSING THE ENVIRONMENTAL IMPACT OF RADIONUCLIDE ECO-

Emory Univ., Atlanta, GA. Dept. of Biology. H. L. Ragsdale.

In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 149-173, 61 Ref.

Descriptors: *Ecotoxicology, *Fate of pollutants, *Water pollution effects, *Radioactive wastes, *Aquatic habitats, *Ecosystems, *Aquatic life, *Environmental effects, *Toxicology, Single species tests, Radioisotopes, Microenvironment.

Single species or microcosm tests have a useful, but limited, role in defining radionuclear impacts on organisms. Some of the uses of single species testing include explaining phenomena observed at the ecosystem level, providing preliminary trials prior to large-scale ecosystem testing, studying in greater detail the specific mechanisms identified from ecosystem testing, developing a baseline of potential impact, developing predictive relationships between dose and response, and analyzing damage mechanisms. Ecosystem testing, however, provides comprehensive and conclusive knowledge of radionuclear ecotoxicant impacts which allows analysis of short-term and long-term impacts, provides data whose transferability to other systems and regions can be evaluated, allows extrapolation with maximum confidence, and allows explicit comparison of the severity of impact from a variety of ecotoxicants.

ECOSYSTEM APPROACH TO THE TOXICOL-OGY OF RESIDUE FORMING XENOBIOTIC ORGANIC SUBSTANCES IN THE GREAT LAKES,

Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.

W. R. Swain.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 193-257, 2 Fig. 18 Tab, 129 Ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Great Lakes, *Toxicology, *Ecosystems, *Aquatic habitats, *Pesticides, *Organochlorine pesticides, Insecticides, *Chlorinated hydrocarbons, Lakes, DDT, Polychlorinated biphenyls, Dieldrin, Lindane, Methoxychlor, Endosulfan, Benzene hexachloride, Plankton, Sediments, Lake sediments, Aldrin, Endrin, Heptachlor, Chlordane, Phthalates, Fish, Public health, Food chains.

A conceptual framework is presented for an eco-A conceptual tramework is presented for an eco-system approach to the question of the impact of residue forming toxic substances of anthropogenic origin in the Great Lakes. This framework is an attempt to link a definite and orderly progression of events related to input sources of toxic substances and their compartmentalization phenom-ena. It is believed to be of utility because it considers interrelationships and properties between sepa-rate entities, incorporates defined criteria, and uti-lizes a series of linkages into which quantifiable

values and numerically precise data can be inserted to enable an adequate mechanism for understanding the fate, transport and effects of toxic organichlorine compounds. Given the magnitude of the Great Lakes ecosystem in both spatial and temporal scales, the interdependency of the various ecosystem compartments and the multiplicity of exogenous substances with differing chemical/biological reactions, it is difficult to conceive that any other approach to the question could adequately cal reactions, it is difficult to conceive that any other approach to the question could adequately address the complexity of the issue. While short term laboratory tests are useful in delineating areas of the environment where problems can be anticipated, often the question of scale makes direct translation of results to the Great Lakes difficult, if not impossible. The approach described in this effort is an attempt to overcome these difficulties for toxic xenobiotic organochlorine compounds. (Author) (Author) W86-00237

LEACHATE FROM HAZARDOUS WASTES

New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
P. N. Cheremisinoff, and K. A. Gigliello.
Technomic Publishing Co., Inc., Lancaster, PA.

1983, 88 p.

Descriptors: *Water pollution sources, *Fate of pollutants, *Leachates, *Landfills, *Water disposal, Solid waste disposal, Sampling, Monitoring, Wells, Model studies, Pollutant identification, Linings, Plastics, Water pollution control, Wastewater treatment, Water pollution effects, Groundwater pollution, Damage.

This report is a guide to the formation, generation, sampling methodology, control, and treatment of leachate from solid waste sites. Four types of disposal sites are defined-dump, landfill, sanitary landfill, and secured landfill. The mechanisms for landfill, and secured landfill. The mechanisms for contamination of groundwater by leachates are described. The processes of infiltration, percola-tion, evaporation, and transpiration are involved in leachate generation. Leachate characteristics vary from site to site. The volume depends on the soil's from site to site. The volume depends on the soil's absorptive capacity, areal extent, composition, placement, cover material and operation, and amount of recharge water available for infiltration. The water balance method may be used to estimate leachate generation. Sampling considerations and methods are given for seeps, wells, and leachate collection systems. Laboratory methods applicable to leachate assessment include modeling techniques, shake tests, saturation tests, column tests, and field test cells. Effects of leachate on lining materials are summarized. Among leachate control methods are proper selection of waste, control of water movement, control of decay, lining with leachate collection, leachate treatment, natural renovation, incineration, aeration, leachate recycle, and integrated treatment systems. Leachate damage, usually contamination of wells, and case histories are described.

STREAM WATER QUALITY IN THE COAL REGION OF ALABAMA AND GEORGIA, Northeastern Forest Experiment Station, Broo

K. L. Dyer. Available from the National Technical Information Service, Springfield, VA 22161, as PB83-1246363. General Technical Report NE-73, 1982. 109 p. 34 Fig. 65 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, Alabama, Georgia, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 58 small streams in 12 counties of Alabama and 3 in Dade County, Georgia, are given for the period July 19, 1977, to August 10, 1979. Twenty of the watersheds were unmined. Thirty-eight of the watersheds had been surface mined, some recently (after 1972) some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia,

nitrate, nitrate plus nitrite, total nitrogen, phosph ntrate; intrate plus intrite; obtainitiogies, priospin-rus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area. W86-00250

STREAM WATER QUALITY IN THE COAL REGION OF WEST VIRGINIA AND MARY-

Northeastern Forest Experiment Station, Berea.

K. L. Dyer.

K. L. Dyer.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118182.

General Technical Report NE-70, 1982. 215 p. 71

Fig. 131 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, West Virginia, Maryland, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 118 small streams in 27 counties of West Virginia and nine streams in two counties of western Maryland are given for the period June 9, 1977, to November 9, 1979, Fortyperiod June 9, 1977, to November 9, 1979. Forty-eight of the watersheds were unmined. Seventy-nine of the watersheds had been surface mined, some recently (after 1972) and some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.

W86-00253

ARCTIC MARINE OILSPILL I (AMOP) REMOTE SENSING STUDY PROGRAM Canada Centre for Remote Sensing, Ottawa (On-

tario). For primary bibliographic entry see Field 7B. W86-00258

MATHEMATICAL MODEL, SERATRA, FOR SEDIMENT-CONTAMINANT TRANSPORT IN RIVERS AND ITS APPLICATION TO PESTICIDE TRANSPORT IN FOUR MILE AND WOLF CREEKS IN IOWA.

WOLF CREEAS IN TOWA.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-122671.

EPA 600/3-82-045, August 1982. Environmental Research Laboratory, Athens, GA. 56 p, 24 Fig, 1 Tab, 26 Ref. Contract/Grant No. 68-03-2613.

Descriptors: *Fate of pollutants, *Model studies, *Sediment transport, *Pesticides, *Streams, *Water quality, SERATRA model, Degradation, Polatility, Hydrolysis, Oxidation, Photolysis, Particulate matter, Finite element method, Four Mile Creek, Wolf Creek, Iowa, Mathematical models, Bottom sediment, Alachlor, Sedimentation.

The sediment-contaminant transport model SERA-TRA was used as an integral part of the Chemical Migration and Risk Assessment Methodology, which simulates migration and fate of a contaminant over the land surface and in receiving streams, to assess potential short- and long-term impact on aquatic biota. SERATRA, an unsteady, two-dimensional (longitudinal and vertical) finite element model, consists of three submodels coupled to include the effects of sediment-contaminant interactions—a sediment transport submodel, a dissolved contaminant transport submodel, and a particulate contaminant (contaminants adsorbed by sediment) transport submodel. The sediment transport submodel simulates transport, deposition, and scouring of three sediment size fractions of cohesive and noncohesive sediments. The dissolved contaminant transport submodel includes mechanisms of contaminant adsorption/desorption and

Sources Of Pollution--Group 5B

contaminant degradation resulting from hydrolysis, oxidation, photolysis, volatilization, biological activities and radionuclide decay to predict migration of dissolved contaminant. The particulate contaminant submodel simulates transport, deposition and scouring of contaminants associated with three size fractions of sediments. SERATRA also predicts changes of bed conditions for sediment and particulate contaminants. (Author)

(2)

PLANNING GUIDE FOR EVALUATING AGRI-CULTURAL NONFOINT SOURCE WATER QUALITY CONTROLS, Cornell Univ., Ithaca, NY. For primary bibliographic entry see Field 5G. W86-00260

STREAM WATER QUALITY IN THE COAL REGION OF OHIO,
Northeastern Forest Experiment Station, Broo-

Northeastern Forest Experiment Station, Broomall, PA.
K. L. Dyer.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB83-119495.
General Technical Report NE-75, 1982. 138 p, 46
Fig, 73 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, Ohio, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 70 small streams in 19 counties of Ohio are given for the period June 1, 1977, to October 4, 1979. Nineteen of the watersheds were unmined. Fifty of the watersheds had been surface mined, some recently (after 1972) and some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.

STREAM WATER QUALITY IN THE COAL REGION OF PENNSYLVANIA, Northeastern Forest Experiment Station, Broomall, PA.

Man, J. P. K. L. Dyer.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124586.

General Technical Report NE-76, 1982. 168 p, 61

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, Pennsylvania, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 86 small streams in 23 counties of Pennsylvania are given for the period July 13, 1977, to October 4, 1979. Twenty-nine of the watersheds were unmined. Fifty-seven of the watersheds had been surface mined, some recently (after 1972) and some mined before 1972. Data included the property of the period (after 1972) and some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus mitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interperation of the data will be presented in a later report covering nine states in the Appalachian area. W86-00281

SURVEY OF POLYCHLORINATED BIPHEN YLS IN INDUSTRIAL EFFLUENTS IN YLS IN CANADA.

Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
Report EPS 3-WP-81-1, March 1981. 19 p, 5 Tab, 26 Ref.

Descriptors: *Water pollution sources, *Fate of pollutants, *Polychlorinated biphenyls, *Organic compounds, *Industrial wastewater, Pulp and paper industry, Aluminum, Paint industry, Chemical industry, Chlorinated hydrocarbons, Canada.

Polychlorinated biphenyls (PCBs) in industrial effluents and process streams in Canada were sampled in two phases: (1) an overall survey involving 308 samples in 31 types of industries and (2) sampling of 45 effluents from 7 selected plants discharging significant quantities of PCBs. Of the 308 samples from general industry, 48 contained more than 0.1 ppb PCB. These industries were pulp and paper, smelting, paint manufacturing, electrical equipment manufacturing, chemicals, sewage treatment, aviation, iron and steel, petrochemicals, mining, poultry packing, waste oil recycling, food products, machine shop, and coal superport. A pulp and paper mill using recycled paper discharged effluents with 28.0-48.2 ppb PCB. Other plants and the PCB concentrations (ppb) of their effluents were aluminum smelting, 0.11-394; paint manufacturing, 0.24-4.66; petrochemicals, 0.42; and chemical manufacturing, 5.1. Likely sources of PCB in the effluents were recycled waste paper, hydraulic fluids, paint pigments, and electrical oils. PCBs, probably with 4 or less chlorine atoms per molecule, may be formed inadvertently by some plant processes (chlorination of waste biphenyls in wastewater treatment or synthesis from certain aromatic compounds). However, none were detected in this study, which did not use analytical methods designed to detect lower-chlorine PCBs. W86-00286 Polychlorinated biphenyls (PCBs) in industrial ef-

USE OF SATELLITE IMAGERY FOR TRACK-ING THE KURDISTAN OIL SPILL, Remotec Applications Ltd., St. John's (Newfound-

For primary bibliographic entry see Field 7B. W86-00291

EFFECTS, PATHWAYS, PROCESSES, AND TRANSFORMATION OF PUGET SOUND CONTAMINANTS OF CONCERN, E.V.S. Consultants Ltd., North Vancouver (British

Columbia).

D. E. Konasewich, P. M. Chapman, E. Gerencher,
G. Vigers, and N. Treloar.

Available from the National Technical Information
Service, Springfield, VA 22161 as PB83-118208.

NOAA Technical Memorandum OMPA-20, July
1982. National Oceanic and Atmospheric Administration, Boulder, CO. 357 p, 35 Fig, 37 Tab, 765

Descriptors: *Fate of pollutants, *Water pollution effects, *Estuaries, Sediments, *Toxicity, *Organic compounds, Benthos, *Puget Sound, Chlorinated hydrocarbons, Polyaromatic hydrocarbons, Naphthalene, Benzo(a)anthracene, Fluoranthenes, Benzo(a)pyrene, Arsenic, Cadmium, Heavy metals, DDT, Insecticides, Pesticides, Polychlorinated biphenyls, Hexachlorobenzene, Phthalates, Copper, Lead, Mercury, Selenium, Silver, Aquatic life, Inorganic compounds, Bioaccumulation, Biodegradation, Water pollution sources.

tion, Water pollution sources.

Toxicity and distribution data on the 183 organic compounds and 37 inorganic ions identified in Puget Sound sediments, biota, and waters were reviewed. The chemicals were classified into six categories based on degree of concern for the environment. The 15 contaminants or classes of contaminants of greatest concern were polychlorinated dibenzofurans and chlorophenol precursors, chlorinated butadienes, polyaromatic hydrocarbons and halogenated derivatives, arsenic, cadmium, DDT and metabolites, polychlorinated biphenyls, hexachlorobenzene and related compounds, chlorinated ethylenes, phthalates, copper, lead, mercury, selenium, and silver. The study concluded that concentrations of many contaminants were higher in the Puget Sound ecosystems than in other areas of the world. Four research needs were identified: (1) develop and implement a surveillance plan to assess trends and fate and effects of pollutants (2) develop an ecological hazard assessment scheme, (3) establish the relationship between levels of contaminants in sedi-

ments and benthic biota and the consequent toxic effects of these levels on biota, and (4) develop additional basic information on the behavior and fate of chemicals in the marine and estuarine envi-W86.00293

EUROPEAN AND UNITED STATES CASE STUDIES IN APPLICATION OF THE CREAMS

al Inst. for Applied Systems Analysis, Laxenburg (Austria).

IIASA Collaborative Proceedings Series CP-82-S11, 1982. Edited by V. Svetlosanov and W. G. Knisel. 148 p.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, CREAMS model.

matical models, CREAMS model.

CREAMS (Chemicals, Runoff, and Erosion from Agricultural Management Systems), a mathematical model for determining nonpoint source pollution, has three components: hydrology, erosion/sedimentation, and chemistry (nutrients and pesticides). Part I describes the model and shows how it is applied. Parts II and III concern case studies in several European countries: Finland, Germany, Poland, Sweden, United Kingdom, and Lithuania (USSR). Part IV looks at the future, CREAMS2, which will incorporate the knowledge obtained in this study. Part V summarizes the basic conclusions. Among the conclusions are (1) CREAMS generally gives good representations of the hydrology, erosion/sediment yield, and chemical processes. It needs revision and addition of certain processes (snowmelt, frozen soil, organic fertilizer, etc.) specific to European conditions. CREAMS is useful for evaluating alternate management alternatives but does not predict absolute quantities. CREAMS should be calibrated when data become available. Although it is a field-scale model, it may CREAMS should be calibrated when data become available. Although it is a field-scale model, it may be a foundation or a component of regional or larger watershed studies. CREAMS2, an improved and more comprehensive model, will also include soil temperature, anowmelt/frozen soil, nitrogen cycling, vertical flux of pesticides, and a totally linked model structure to simplify process interactions and model feedback. W86-00294

CREAMS: A SYSTEM FOR EVALUATING MANAGEMENT PRACTICES ON FIELD-SIZE AREAS,

Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center. W. G. Knisel, G. R. Foster, M. H. Frere, R. A.

W. G. Knisel, G. R. Foster, M. H. Frere, R. A. Leonard, and A. D. Nicks. In: European and United States Case Studies in Application of the CREAM Model, IIASA Col-laborative Proceedings Series CP-82-S11, 1982. p 7-40, 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultral hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, *Mathematical models, Fertilizers, Leaching, CREAMS model.

CREAMS (Chemicals, Runoff, and Erosion from CREAMS (Chemicals, Runoff, and Erosion from Agricultural Management Systems) is a field-scale mathematical model for assessing nonpoint source pollution and evaluating alternate practices for controlling pollution from sediments and chemicals. CREAMS consists of three major components: hydrology, erosion/sedimentation, and chemistry. The hydrology component estimates storm runoff by either of two options, depending on availability of rainfall data: (1) with daily rainfall data and (2) by an infiltration-based method. The erosion component considers the basic processes of soil detachment, transport, and deposition. The chemistry component concerns plant nutrients The chemistry component concerns plant nutrients and pesticides. An example shows the application

Group 5B—Sources Of Pollution

of CREAMS to a 3.2-acre field in the Georgia W86-00295

TESTING THE APPLICATION OF CREAMS TO FINNISH CONDITIONS, National Board of Waters, Helsinki (Finland).
L. Kauppi.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 43-47, 2 Tab, 3 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Hovi Basin, *Finland, CREAMS

The CREAMS model was applied to the agricultural Hovi basin in Finland. The area under study used the open ditch drainage system. Yearly runoff plus percolation in 1968 was 265 mm (calculated 288 mm) and in 1969 was 223 mm (calculated 229 mm) and in 1969 was 220 mm (calculated 229 mm) and in 1969 was 220 mm (calculated 229 m 288 mm) and in 1969 was 223 mm (calculated 229 mm). The daily response lagged by a day because of the ditch system. Soil losses were calculated from the model and from suspended solido concentrations in runoff waters. In 1968 soil loss (in tons per sq km) was 110 (from model) and 14 (from suspended sediments). In 1969 soil loss (in tons per aq km) was 88 (from model) and 24 (from suspended sediments). Nitrogen and phosphorus losses calculated by the model were significantly greater than those calculated from concentrations and runoff observations, particularly in autumn. The model needs modifications to adapt well to Finnish conditions. These considerations include a snow-melt component and further work on calibration melt component and further work on calibration and selection of appropriate parameter values. W86-00296

ENVIRONMENTAL EFFECTS OF NITROGEN FERTILIZATION EXEMPLIFIED BY GROUNDWATER POLLUTION AS SIMULAT-ED BY CREAMS,

Goettingen Univ. (Germany, F.R.).
S. Stemmler.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 49-62, 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Nitrogen, Agricultural chemicals, *Mathematical models, Fertilizers, Nitrates, Mussum water reserve, Germany, Leaching, CREAMS model.

The CREAMS model was tested in the Mussum water reserve area of northwestern Germany. In the hydrology submodel the first runs underestimated percolation (120-180 mm calculated, 300 mm actual) and overestimated evapotranspiration. Changes in the program and equations produced good results in later runs. Nitrate was the only chemical considered in the study. It was possible to quantify the relation between fertilization intensity (up to 480 kg N per ha) of arable land and nitrate concentrations in the water percolated below the root zone. However, results were applicable only to the thin and uniformly distributed aquifers in the study area. study area. W86-00297

APPLICATION OF THE CREAMS MODEL FOR CALCULATION OF LEACHING OF NI-TRATE FROM LIGHT SOILS IN THE NOTEC

TRATE FROM LIGHT SOILS IN THE NOTEC RIVER VALLEY, Institute for Land Reclamation and Grassland Farming, Raszyn (Poland). A. Sapek. In: European and United States Case Studies in Application of the CREAMS Model, IIASA Col-laborative Proceedings Series CP-82-S11, 1982. p laborative Proceedings Series CP-82-S11, 1982. p 63-70, 5 Tab, 1 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Nitrates, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Notec River Valley, Poland, CREAMS model, Denitrification.

The CREAMS model was used for calculation of the amount of leached nitrate below the plant root zone and of the nitrogen balance in light soil with average physical properties occurring in the Notec River valley, Poland. The simulation was performed with the precipitation data for the period 1960-1979. The calculated nitrate leaching averaged about 25 kg N per hectare per year, which constitutes a threat for the water quality and fertilizer economy. Higher nitrogen losses from soil were due to the denitrification process. The largest amounts of nitrate leached and percolation occurred in the autumn-winter months. It seems that the most feasible method of verification of the reliability of model output would be the measurement of the content of nitrate in soil after and before the growing season. (Author) before the growing season. (Author) W86-00298

APPLICATION OF THE CREAMS MODEL: WESTERN SKANE, SWEDEN, Lund Univ. (Sweden). Dept. of Water Resources

In: European and United States Case Studies in Application of the CREAMS Model, IIASA Col-laborative Proceedings Series CP-82-S11, 1982. p 71-82, 4 Fig. 2 Tab, 11 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Nitrates, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Skane, Sweden, Potatoes, Wheat, CREAMS model.

The hydrology and nutrient components of the CREAMS model were used to evaluate the nitrate leaching from agricultural fields in Skane, at the southern tip of Sweden. Annual leaching amounts corresponded fairly well to results obtained from field experiments. However, CREAMS should not be used to predict absolute quantities. In particular, a small error in estimating percolation in summer causes large errors in leaching output. The model proved useful for comparing nitrate leaching produced from several management practices: potatoes with rain and rain/irrigation; wheat with rain and rain/irrigation. and rain/irrigation. W86-00299

PREDICTING HILLSLOPE RUNOFF AND EROSION IN THE UNITED KINGDOM: PRE-LIMINARY TRIALS WITH THE CREAMS MODEL.

National Coll. of Agricultural Engineering, Silsoe

Radional Coll. of Agriculture (England).
R. P. C. Morgan, and D. D. V. Morgan.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 83-97, 4 Tab, 15 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, *Non-point pollution sources, Agricultural hydrology, *Mathematical models, Silsoe, United Kingdom, Runoff, Slopes, CREAMS model.

Promising results are obtained when the CREAMS model is applied to soil losses in the Silsoe area, United Kingdom. Soil loss predictions are reasonable under these conditions: (1) the concept of channel erosion is extended to include convergences of flow within the overland flow whenever sediment concentrations exceed a critical threshold and (2) observed runoff depths from unbounded plots are calculated with the 1-sq m strategy. The hydrology submodel shows promise as a runoff predictor if the observed runoff is calculated with the 1-sq m strategy. The 10-sq m strategy involves converting

the observed runoff volumes to an average depth over 10 sq m; the 1-sq m strategy does the same over a 1-sq m area. W86-00300

APPLICATION OF THE CREAMS MODEL AS PART OF AN OVERALL SYSTEM FOR OPTI-MIZING ENVIRONMENTAL MANAGEMENT IN LITHUANIA, USSR: FIRST EXPERIMENTS, Lithuanian Research Inst. of Forestry, Vilnius

L. Kairiukstis, and G. Golubev.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 99-119, 9 Fig, 3 Tab, 5 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Lithuania, Forests, CREAMS model.

First experiments with the CREAMS model show that it is suitable for predicting hydrology, erosion, and nutrient transport for the conditions in Lithuania. However, it will be necessary to modify the model to compensate for the long, stable snow cover, the high groundwater level, and the processes associated with snowmelt. Although CREAMS was developed for agricultural land, it shows promise for use in forested lands. W86-00301

REVIEW OF CASE STUDIES OF CREAMS MODEL APPLICATION,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
W. G. Knisel, and V. Svetlosanov.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Collaborative Proceedings Series CP.87-S11 1022 laborative Proceedings Series CP-82-S11, 1982. p 123-135, 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, Czechoslovakia, Germany, Finland, Lithuania, Poland, Sweden, United Kingdom, CREAMS model.

The application of the CREAMS model in these case studies (Czechoslovakia, Germany, Finland, Lithuania, Poland, Sweden, and United Kingdom) have resulted in identification of model limitations and areas which call for improvements. Also, they have shown that CREAMS gives generally good results, and the model is a tool that can be used to aid in development of agricultural management practices for nonpoint source pollution control. Validation with observed data has shown that CREAMS is a suitable model for extrapolating research results to other climatic and soil regions. Although the model gives reasonable results in simulation, it is desirable to calibrate it with data where possible. (Author)

ETHYLENE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.

Environmental Protection Service, Ottawa (Ontar-For primary bibliographic entry see Field 5C. W86-00303

5C. Effects Of Pollution

RAPIDITY OF RNA SYNTHESIS IN HUMAN CELLS; A HIGHLY SENSITIVE PARAMETER FOR WATER CYTOTOXICITY EVALUATION, Service de Controle des Eaux de la Ville de Paris

Effects Of Pollution—Group 5C

For primary bibliographic entry see Field 5A. W86-00052

WASTEWATER REUSE AND EXPOSURE TO LEGIONELLA ORGANISMS, Hadassah Medical School, Jerusalem (Israel). En-vironmental Health Lab. B. Fattal, H. Bercovier, M. Derai-Cochin, and H.

H. Shuval.

Water Research, Vol. 19, No. 6, p 693-696, 1985. 1
Fig, 2 Tab, 19 Ref.

Descriptors: *Wastewater reuse, *Legionella, *Bacteria, *Public health, Wastewater disposal, Human physiology, Water pollution effects, Fish

Eight hundred and fifty-two (852) blood sera were drawn in 1980 and 1981 from populations residing in 30 agricultural settlements (having a total popu-lation of 16,240). These sera were tested for the presence of antibodies against 15 different antigens presence of antibodies against 15 different antigens of Legionella species (L. pneumophila serogroups 1-8 and seven other Legionella, i.e. bozemani, gormanii, micdadei, jordanis, dumoffi, longbeacheae and oakridgensis). The results indicate a significant (P < 0.02) excess in the percentage of sera positive for L. pneumophila (serogroups 1-8) among sewage and non-sewage irrigation and fish pond workers as compared to the control group (4.5% vs 1.5%). For the other Legionella species, there was no difference among the above groups. The isolation of L. pneumophila serogroup 4 and five organisms resembling Legionella spp from one oxidation pond used for irrigation strengthens the seroepidemiological findings. (Author's abstract) W86-00054

PASSAGE OF SELECTED HEAVY METALS FROM SPHAEROTILUS (BACTERIA: CHLA-MYDOBACTERIALES) TO PARAMECIUM CAUDATUM (PROTOZOA: CILLATA), Middle Tennessee State Univ., Murfreesboro. M. Mansouri-Aliabadi, and R. E. Sharp. Water Research, Vol. 19, No. 6, p 697-699, 1985. 2 Tab, 18 Ref.

Descriptors: *Heavy metals, *Sphaerotilus, *Paramecium, *Bacteria, *Bioconcentration, Metals, Protozoa, Bioaccumulation, Zinc, Lead, Manganese, Nickel, Water pollution effects.

nese, Nickel, Water pollution effects.

The ability of ciliates to purify turbid activated-sludge effluents has been suggested to be the result of predation upon bacteria and floculation of living and non-living suspended matter. One factor which brings about the absence or reduction in number of ciliated protozoa in activated sludge is the introduction of toxic metals, often as by-products of industrial processes. The possibility that passage of heavy metals occurs from bacteria to protozoa was investigated. Paramecium caudatum protozoans were freed from their associated bacteria and thrived on Sphaerotilus, a bacterium occurring in polluted waters, as their only food source. Sphaerotilus was found to take up Zn, Pb, Ni and Mn; metal-containing cultures of this bacterium were employed to feed P. caudatum, and analytical results revealed the accumulation of Zn, Pb and Ni. The bacteria did not pass Mn to the animals at all even though uptake of Mn by Spaerotilus was relatively high when compared with other metals used in this study. No metals were found in control cultures of paramecia. Since Sphaerotilus was the only food source for paramecia during this study, the results indicate that trace amounts of metals were passed from bacteria to protozoa in a predator-prey relationship. (Collier-IVI)

HEAVY METAL ACCUMULATION (CD, CU, PB AND ZN) BY SMELT (OSMERUS MORDAX) FROM THE NORTH SHORE OF THE ST LAWRENCE ESTUARY (ACCUMULATION DE QUELQUES METAUX LOURDS (CD, CU, PB ET ZN) CHEZ L'EPERLAN (OSMERUS MORDAX) PRELEVE SUR LA RIVE NORD DE L'ESTILAIRE NUL SINTI LA RIPENTO. L'ESTUAIRE DU SAINT-LAURENT), Quebec Univ., Rimouski. Dept. of Oceanography. M. Arnac, and C. Lassus.

Water Research, Vol. 19, No. 6, p 725-734, 1985. 4 Fig. 3 Tab. 29 Ref.

Descriptors: *Heavy metals, *Bioaccumulation, *Smelt, *Fish, *St. Lawrence Estuary, *Cadmium, *Copper, *Zinc, *Lead, Metals, Fish physiology, Water pollution effects, Animal tissues, Animal physiology.

A method of physiologically removing metals in marine organisms is by storage in a particular tissue. Several different sites for storing metals were investigated and concentrations of Cd, Cu, Pb and Zn were examined in muscle, liver and gonads of smelt (Osmerus mordax) from the North shore of the St. Lawrence estuary. A modified wet digestion procedure was used to prepare biological samples for the determination of trace elements by flameless atomic absorption spectrophotometry. digestion procedure was used to prepare biological samples for the determination of trace elements by flameless atomic absorption spectrophotometry procedure, using calibration standards made up in a matrix of similar acidity. NBS bovine liver reference material was analyzed along with the samples; results were within the specified tolerance. Analyses were reported on a dry weight basis. Copper (range 0.3-3.3 micro-g/g) and zinc (range 19-38 micro-g/g) in muscle fillets were found to be negatively correlated with total body weight. Livers and gonads contained greater levels of the four metals than somatic muscle. Liver metal concentrations of Zn (range 29-108 micro-g/g) and Cd (range 0.06-0.37 micro-g/g) increased with total body weight. All equations fit data at P < 0.01. Positive correlations between size and metal concentrations suggest that net uptake may occur. Increasing metal concentrations in liver may represent storage of sequestered products in that organ. In the gonads, no significant relationship exists between total body weight and trace metal contents. Females had significantly greater Cu and Zn concentrations, but no significant difference existed between males and females for Cd concentrations. The relation between concentration and total body weight appears to be specific as to the species, tissues analyzed and environmental conditions. The comparison of metal concentrations in fish to assess variations in contamination levels requires understanding the relationship between metal concentration and body size within each population. (Coline-IVI) W86-00059

TOXICITY TO DAPHNIA OF THE END PRODUCTS OF WET OXIDATION OF PHENOL AND SUBSTITUTED PHENOLS,
Michigan Technological Univ., Houghton. Dept. of Biological Sciences, bibliographic entry, see Field SD.

For primary bibliographic entry see Field 5D. W86-00064

WATER-QUALITY APPRAISAL, MAMMOTH CREEK AND HOT CREEK, MONO COUNTY, CALIFORNIA, Geological Survey, Sacramento, CA. Water Re-sources Div.

For primary bibliographic entry see Field 5A. W86-00106

PRELIMINARY EVALUATION OF LAKE SUS-CEPTIBILITY TO WATER-QUALITY DEGRA-DATION BY RECREATIONAL USE, ALPINE LAKES WILDERNESS AREA, WASHINGTON, Geological Survey, Seattle, WA. Water Resources

Div. R. J. Gilliom, P. Dethier, S. A. Safioles, and P. L.

USGS Water-Resources Investigation Open-File Report 80-1124, 1980. 1 p, (map and text), 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Water quality, *Water pollution control, *Recreation planning, *Wilderness lakes, *Land use, Nutrients, Phosphorus, Pathogens, Maps, *Washington, Alpine Lakes Wilderness Area, *Alpine Lakes.

The relative susceptibility of lakes in the Alpine Lakes Wilderness Area to water-quality degradation was evaluated from two perspectives: (1) water-quality sensitivity, which is the tendency of a lake's water quality to degrade in response to

pollutant loading, and (2) pollutant-loading likelihood, which is determined by the presence of drainage-basin features that enhance the transport of pollutants to a lake. Water-quality sensitivity was evaluated for 60 lakes, using a mass-balance phosphorus model to predict the response of each lake to a hypothetical 'worst-case' increase in phosphorus loading. This evaluation suggested that lakes in the Alpine Lakes Wilderness Area generally are not sensitive to foreseeable increases in phosphorus loading because of their high rate of dilution and flushing. Pollutant-loading likelihood was evaluated according to the amount of seasonal wet area' near a lake and in the drainage basin. Of 298 lakes evaluated for pollutant-loading likelihood, 74 lakes were rated moderate to high. On the basis of these findings, lakes in the Alpine hood, 74 lakes were rated moderate to high. On the basis of these findings, lakes in the Alpine Lakes Wilderness Area are generally not considered susceptible to long-term degradation as a result of recreational use, but some lakes are prob-ably susceptible to temporary local pollution. The nature of this potential problem, and knowledge of natural features of the Alpine Lakes Wilderness Area, suggest an approach for managing recreation so that the risk of water-quality degradation is minimized. (USGS) W86-00114

RESULTS OF AN ADAPTIVE ENVIRONMEN-TAL ASSESSMENT MODELING WORKSHOP-CONCERNING POTENTIAL IMPACTS OF DRILLING MUDS AND CUTTINGS ON THE MARINE ENVIRONMENT,

MARINE ENVIRONMENT,
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
G. T. Auble, A. K. Andrews, R. A. Ellison, D. B. Hamilton, and R. A. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-114165.
Environmental Research Laboratory, Gulf Breeze, FL. EPA-600/9-82-019. October 1982. 64 p. 33 Fig. 6 Tab, 14 Ref., 1 Append. Contract/Grant No. EPA-81-D-X0581.

Descriptors: *Drilling fluids, *Environmental effects, *Marine environment, Drilling cuttings, Bays, Drilling, Drilling mud, Gulf of Mexico.

This publication summarizes the findings of a workshop held September 14-18, 1981 between the United States Environmental Protection Agency and the United States Fish and Wildlife Service. and the United States Fish and Wildlife Service. Discussions focused on information pertaining to fate and effects, identification of general relationships between drilling mud fluids and the marine environment, and identification of site-specific variables likely to determine impacts of drilling muds and cuttings in various marine sites. The workshop was structured around the construction of a model simulating fate and effects of discharges from a single rig into open waters of the Gulf of Mexico. Factors that might produce different fate and effects in enclosed areas such as bays and estuaries also were discussed. Considerable knowledge (such as that concerning fate and physical effects of dredge spoil) that could be effectively employed in analysis of potential fate and physical effects in enclosed areas was identified.

W86-00147 W86-00147

LABORATORY PROTOCOLS FOR EVALUAT-ING THE FATE OF ORGANIC CHEMICALS IN AIR AND WATER, SRI International, Menlo Park, CA. For primary bibliographic entry see Field 5A.

For primar W86-00154

LONG-TERM IMPACT OF DREDGED MATE-RIAL AT TWO OPEN-WATER SITES: LAKE ERIE AND ELLIOT BAY; EVALUATIVE SUM-MARY

Army Engin Engineer Waterways Experiment Station, urg, MS. Environmental Lab. H. E. Tatem.

Technical Report D-84-5, November 1984. Final Report. 37 p, 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Dredging, *Lake Erie, *Water pollution effects, *Solid waste disposal, *Ecological ef-

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C-Effects Of Pollution

fects, Polychlorinated biphenyls, Microorganisms, Mollusks, Polychaetes, Benthos, Waste disposal, Water pollution.

Dredged material disposal sites in Lake Erie and Elliott Bay were studied in 1979-1980 and results were compared with those obtained in 1975-1976 from studies at the same sites. The Lake Erie disposal sites contained more gravel and sand than control areas. In general the microfaunal animals were less abundant at the Lake Erie disposal sites which were richer in meiofauna. No differences in which were richer in meiofauna. No differences in Hg or Cd levels were found between disposal and control sites. The disposal mound created in 1975-1976 in Elliott Bay had stabilized physically and chemically. The mound area contained more ani-mals than the surrounding bottom areas. Bivalves and polychaetes were the dominant animals found of the Ellist Bay directed its. Even animals token and polychaetes were the cumulant animals found at the Elliott Bay disposal site. Some animals taken from the disposal mound contained polychlorinat-ed biphenyls at levels slightly higher than sediment levels which were in the 2.0- to 3.0-ppm range. W86-00160

LONG-TERM IMPACT OF DREDGED MATERIAL DISPOSAL IN LAKE ERIE OFF ASHTA-BULA, OHIO, Weston (Roy F.), Inc., West Chester, PA

Weston (Roy F.), Inc., West Chester, PA.
K. J. Salamon.
Technical Report D-84-3, September 1984. Final
Report. Army Engineer Waterways Experiment
Station, Vicksburg, MS. 123 p. 41 Fig. 15 Tab. 40
Ref. 6 Append. Contract/Grant No. DACW39-79-

Descriptors: *Dredging, *Sediment disposal, *Sediments, *Benthic fauna, *Ecological effects, *Heavy metals, Benthos, Aquatic animals, Mercury, Cadmium, *Dredging spoil, Bioaccumulation, Silt, Sand.

Animal, sediment, and water samples obtained from three Lake Erie disposal sites containing material dredged from Ashtabula Harbor were analyzed for sediment characteristics, benthic animals and Hg and Cd levels. Results were compared with those of two nearby reference areas and with results of studies conducted in 1975 and 1976. Disposal sites contained more gravel and sand than the reference sites which were redominantly silt. the reference sites which were predominantly silt and clay. A number of macrofauna and meiofauna benthic animals were found at both disposal and reference areas. In general, more macrofaunal anireference areas. In general, more macrofaunal animals and a greater variety of species were found at the reference areas. Only the macrofauna were statistically more abundant at the reference areas. Sediment analyses showed the reference or control areas contained higher levels of Hg compared to the disposal areas. For Cd the opposite was true. There were higher Cd levels at the disposal areas. The differences in metal concentrations at disposal There were nigner Cd levels at the disposal areas. The differences in metal concentrations at disposal and reference sites were not statistically significant. Tissue analyses showed that animals at the reference areas contained higher levels of Hg and Cd compared to disposal area animals. W86-00162

VOLUNTEER LAKE MONITORING, 1981,

VOLUNIEER LAKE MUNITURING, 1981, Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control. D. F. Sefton, and J. R. Little. Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119180. Report No. IEPA/WPC/82-006, June 1982. 138 p, 20 Fig, 6 Tab, 28 Ref, 4 Append.

Descriptors: *Lakes, *Water pollution effects, *Monitoring, *Limnology, *Transparency, *Water quality, Illinois, Eutrophication, Stratification, Thermal stratification, Trophic level, Data acquisition, Glacial lakes, Lake morphology, Reservoirs, Lake classification, Aquatic life, Aquatic plants, Aquatic animals, Algae, Ecosystems, Food chains, Photosynthesis, Respiration, Lake stages, Water pollution sources, Water quality control, Septic tanks.

This report summarizes the methods and results of the Illinois EPA 1981 volunteer lake monitoring program. Secchi disc transparency, total depth, and field observations were recorded by 141 vol-

unteers monitoring 87 lakes. Lakes ranged in transparency from 137.9 inches (Arbor in DuPage County) to 7.3 inches (Royal in Calhoun County). The clearest lakes were generally in the northwestern and southern part of the state; the most turbid, in the central and southcentral regions. Average transparencies of less than 4 ft (minimum recommended for bathing beaches) were reported in 63 of the 87 lakes. About 1/3 of the lakes had average values less than 2 ft, indicating use impairment problems. None of the monitored lakes were classified oligotrophic, 9 were mesotrophic, and the remainder were eutrophic. A primer of basic information on Illinois lakes for the layman is given. This includes origin, shape, hydrology, ecosystems, thermal stratification, succession and eutrophication, pollution, and water quality control measures.

METHODS FOR ECOLOGICAL TOXICOLOGY: A CRITICAL REVIEW OF LABORATORY MULTISPECIES TESTS.

Oak Ridge National Lab., TN. Environmental Sciences Div

Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Anna S. Hammons. 307 p.

Descriptors: *Water pollution effects, *Toxicology, *Chemical wastes, Ecological effects, Environmental effects, Aquatic habitats, Aquatic plants, Algae, Predation, Fish, Sediments, Zooplankton, Parasites, Population dynamics, Ecosystems, Mathematical models, Model studies, Invertebrates, Predation, Microorganisms, Arthropods, Insects, Soil, Litter, Animals, Plant's, Mycorrhizae.

Selected laboratory methods for measuring ecological effects of toxic substances were critically evaluated. Criteria used in the evaluation were whether or not the tests were rapid, reproducible, relatively inexpensive, unequivocal, sensitive, socially relevant, predictive, generalizable, and well-developed. Tests recommended for research and development were as follows: in aquatic test systemszooplankton-zooplankton predation tests, fish-zooplankton-gredation tests, parasitism, zooplanktonalgal grazing tests, pelagic microcosms, and model streams; in terrestrial test systems—population interactions and ecosystems; and mathematical models—ecosystem paramater handbook, model validation methods, theoretical studies (multipopulation models, loop analysis, input-ouput analysis).

SURVEY OF NATIONAL AND STATE REGU-LATORY AGENCY POLICY AND PROCE-DURES FOR THE DETERMINATION OF THE TOXICITY OF WASTEWATER EFFLUENTS. Ecological Analysts, Inc., Sparks, MD. For primary bibliographic entry see Field 6E. W86-00211

LONG-TERM ECOLOGICAL BEHAVIOUR OF ABANDONED URANIUM MILL TAILINGS; 2.: GROWTH PATTERNS OF INDIGENOUS VEGETATION ON TERRESTRIAL AND SEMI-AQUATIC AREAS,
Toronto Univ. (Ontario). Inst. for Environmental

Report EPS 3/HA/2, December 1984. 98 p, 29 Fig. 17 Tab, 62 Ref.

Descriptors: *Water pollution effects, *Mine wastes, *Vegetation, *Uranium mill tailings, Spoil banks, Industrial wastes, Acid mine drainage, Trees, Catails, Aquatic plants, Growth, Wetlands, Plant populations, Aspen trees, Birch trees.

The effect of abandoned or inactive uranium mill The effect of abandoned or inactive uranium mill tailings on natural vegetation was studied in Ontario. Cattails have invaded the semi-aquatic areas. All communities were essentially monocultures of Typha latifolia, T. angustifolia, or T. glauca. Sedges, wool grass, and reed grass were found in transition zones between the cattails and the dry tailings. Cattail growth appeared to depend on the hydrological conditions, rather than on the chemical nature of the tailings. The root zones were less

acidic than the soil surface. Decomposition coefficients of the cattail stands were comparable to those in control stands. Trees, mainly trembling aspens and white birch, have colonized the uraniaspens and wine order, nave colonized the drain untailings. Tree heights were similar regardless of site treatment (fertilizer and limestone application). However, when compared with trees in control sites, the trees appeared stunted and growing at their limits of ecological tolerance.

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN: ECONOMIC AND SOCIAL IMPACTS OF GROUNDWATER CONTAMINA-TION; A CASE STUDY IN EAST BAY TOWN-SHIP, GRAND TRAVERSE COUNTY, MICHI-

Northwest Michigan Regional Planning and Development Commission, Traverse City.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132670.
MI/DNR/GW-82/07, June 1982. 22 p. EPA Grant

Descriptors: *Water pollution effects, *Ground-water pollution, *Water quality, *Water supply, Social impact, Economic impact, East Bay Township, Grand Traverse County, Michigan, Municipal water, Groundwater management, Local governments, Organic compounds, Attitudes, Public opinion, Water costs, Wells.

opinion, Water costs, Wells.

The social and economic impacts of groundwater contamination in East Bay Township, Grand Traverse County, Michigan, were surveyed in the Avenue E area where city water service was extended to potentially 102 homes. Contamination consisted of several toxic chemicals, which produced strong odor and foaming in the water supply. Most residents were retired or older working persons for whom additional expenses could significantly impact their budgets. The residents perceptions of and reactions to their well water contamination were closely associated with what they could see or understand about water quality. All residents coped with the problems with varying degrees of hardship. The largest economic factor was the city water hookup. However, most residents had enough funds set aside for such an emergency. The contamination affected property values, a fact that most residents did not perceive. The most common social impact was lack of water. Other social impacts were frustration over the lack of information and over the water rate negotiations. All residents wanted the responsibility for the contamination resolved as a step toward cost reimbursement. In general the property owners' confidence in the government agencies involved in the problem did not diminish. The township government incurred costs of \$13,200; the additional work was a major burden for the small staff. mall staff. W86-00218

WORKING PAPERS PREPARED AS BACK-GROUND FOR TESTING FOR EFFECTS OF CHEMICALS ON ECOSYSTEMS.

National Research Council, Washington, DC. Committee to Review Methods for Ecotoxicology. Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132811. National Academy Press, Washington, DC. 1981. 257 p.

Descriptors: *Water pollution effects, *Fate of pol-lutants, Lakes, *Ecosystems, Toxicology, *Aquatic habitats, *Aquatic animals, *Environmental effects, Microenvironment, *Toxic wastes, *Ecotoxico-

The eleven working papers in this volume were prepared for the study of the committee to Review Methods for Ecotoxicology. The charge to the Committee was to identify characteristics of ecological systems that would indicate hazardous effects of chemicals beyond the level of single species, to establish criteria for suitable testing schemes, and to evaluate the effectiveness of available test systems in assessing effects of chemicals within ecosystems. To assist in its deliberations on

Effects Of Pollution—Group 5C

the broad range of issues to be addressed, the Committee sought additional input from a number of experts. The working papers address a variety of topics: the use of microcosms as a testing scheme in terrestrial and aquatic systems; lethal gene distribution and diatoms as monitoring techniques for hazard assessment of chemicals in ecosystems; special problems associated with hazard assessment of wetlands and watersheds; approaches to assessing the environmental impact of radionuclide and xenobiotic organic substances; a general review of ecosystem properties relevent to ecotoxicology; and a discussion of the advantages and disadvantages of various classes of ecological tests. (Author) (Author) W86-00230

LAKES AND MICROCOSMS: EXTENDING MICROCOSM DATA TO AQUATIC ECOSYS-

TEMS, California Univ., Berkeley. Lawrence Berkeley

P. H. Gleick

In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 18-49, 76 Ref.

Descriptors: *Water pollution effects, *Lakes, *Aquatic habitats, *Ecosystems, *Microcosms, *Aquatic animals, Temperature, Nutrients, Fish, Plankton, Water quality, Transparency, Phosphorus, Biomass, Turbidity, Fish food, Phytoplankton, Algae, Oxygen depletion, Predation, *Microenvironment

onment.

Microcosms can be used to determine the effects of toxic materials on aquatic ecosystems. One limitation of microcosms is the difficulty in accurately modeling certain important ecosystem parameters such as fish productivity, water transparency, odor, and disease vectors. These macrovariables are often influenced by microvariables (temperature, composition and productivity of plankton communities, water composition, and microbial decomposition activity). By analyzing in microcosms the effects of perturbations on microvariables, and by using field data on the correlations between these micro- and macrovariables, it is possible to deduce data on how a macrovariable may react to a given environmental perturbation. Among the most promising correlations are phosphorus levels with fish yields and transparency, total dissolved solids with standing crop of fish, and chemical concentration (e.g., ammonia) levels with oxygen depletion and fish kills.

W&6.00231 concentration (e.g., amm depletion and fish kills. W86-00231

OPTIMUM MICROCOSMS FOR LAKE ECO-TOXICOLOGY,
California Univ., Berkeley, Lawrence Berkeley

J. Harte In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p

Descriptors: *Water pollution effects, *Lakes, *Aquatic habitats, *Ecosystems, *Microcosms, *Aquatic animals, *Toxicology, Gnotobiotic initiation, Whole-water-sample initiation, Surface growth, Biomass, Turbidity, Fish food, Phytoplankton, Algae, Oxygen depletion, Predation, Ecotoxicology, Microenvironment.

Many options are available for the design, initiation, and operation of lake-like microcosms. The choices selected will have a large influence on the realism of the results of ecotoxicological studies conducted with these microcosm. Hydraulically closed systems, initiated by the whole-water-sample method, and periodically poured into clean containers to prevent surface growth will behave most like the parent lake with respect to both chemical and biotic parameters. It is also likely that such systems will provide the most realistic information about the pathways and effects of toxic substances. Replicability is often poor when organisms are initially present in small numbers. Generally, no added replicability or realism is obtained

by increasing the complexity and expense of the microcosm. For example, whole-water-sample initiation is easier than gnotobiotic initiation, closed systems are simpler than chemostats, and surface growth control by periodic pouring is easier than other means. However, this does not apply to incorporation of a benthic compartment in a microcosm. Crocosm. W86-00232

CHEMICALS AND WETLANDS,

CHEMILALS AND ACTION OF THE ACTION OF T

Descriptors: *Fate of pollutants, *Wastewater treatment, *Wetlands, *Chemicals, *Aquatic habitats, Water quality, Advanced wastewater treatment, Microbial degradation, Biological wastewater treatment, Buffering, Nutrients, Nitrogen, Phosphorus, Aquatic plants, Heavy metals, Bottom sediments, Organic compounds, Halogenated hydrocarbons, Hydrocarbons, Biochemical oxygen demand, Chemical oxygen demand, Pathogens, Bacteria, Coliforms, Viruses.

demand, Pathogens, Bacteria, Coliforms, Viruses.

Wetlands have certain characteristics which must be considered during an environmental assessment of toxic chemicals on the ecosystem. Wetlands appear to have a buffering systems (with respect to pH, alkalinity, and hardness), which tends to maintain a stationary operating point under natural and man-made stress. Water quality varies with time (diurnal, seasonal, historical) and water flow distance. The hydrologic regime must be fully understood the understand the variation of chemical parameters. Sediment is the site of action for most uptakes and initial storages of chemicals. Uptake by plants and subsequent return to the sediment often takes many months, while epiphytes perform similarly, but on a time scale of hours. Nitrogen and phosphorus show a cyclic behavior, and microbial processes are very important in nutrient uptake processes. Heavy metals are absorbed aquatic plants and sediments, with more entering the sediments in most wetlands. Refractory chemicals such as hydrocarbons or halogenated hydrocarbons are often slowly degraded by microbial processes. Advanced wastewater treatment using wetlands usually has excellent BOD and COD reduction. The fate of viruses and bacteria in wastewater applied to wetlands has been studied with variable results.

W86-00233

ECOTOXICOLOGY AT THE WATERSHED

Pacific Northwest Forest and Range Experis Station, Corvallis, OR. Forestry Sciences Lab. For primary bibliographic entry see Field 5B. W86-00234

UTILITY OF SINGLE SPECIES AND ECOSYSTEM TESTS IN ASSESSING THE ENVIRON-MENTAL IMPACT OF RADIONUCLIDE ECO-

MENTAL IMPACT OF RADIONUCLIDE I TOXICANTS, Emory Univ., Atlanta, GA. Dept. of Biology. For primary bibliographic entry see Field 5B. W86-0023

CLASSES OF ECOTOXICOLOGICAL TESTS: THEIR ADVANTAGES AND DISADVANTAGES FOR REGULATION, California Univ., Berkeley. Lawrence Berkeley

R. A. Schneider

In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 175-191, 24 Ref.

Descriptors: "Water pollution effects, "Aquatic habitats, "Microcosms, "Ecosystems, "Toxicology, Single species tests, "Environmental effects, Field tests, "Ecotoxicology, Microenvironment,

Three classes of ecotoxicological tests, single-species, microcosm, and field tests, are discussed and evaluated for their usefulness in toxic substance regulation. Criteria for evaluation are ability to predict ecosystem-level effects, replicability, standardizability, speed, simplicity, and cost. The major conclusion is that microcosms of intermediate complexity and small field plots are presently the most useful tools for ecotoxicological testing and hazard evaluation. (Author) W86-00236

ECOSYSTEM APPROACH TO THE TOXICOLOGY OF RESIDUE FORMING XENOBIOTIC ORGANIC SUBSTANCES IN THE GREAT

Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station. For primary bibliographic entry see Field 5B. W86-00237

RESTORATION OF HABITATS IMPACTED BY OIL SPILLS,

Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr. 182 p.

Descriptors: *Oil spills, *Ecological effects, *Oil pollution, Symposium, *Water pollution effects, *Water pollution control, *Cleanup operations, Tidal flats, Salt marshes, Coral reefs, Mangrove swamps, Beaches, Shores, Sea grasses, Tundra, Habitats, Fisheries, Environmental impact statement, Conferences, Ecosystems.

This book presents reports of a workshop held at the Virginia Polytechnic Institute and State University on November 9-11, 1981. The workshop convened scientists from various backgrounds to review the problem of oil spills and determine courses of action that may include possible means for restoration of impacted habitats. Seven chapters authored by different scientists cover the following topics: recovery and restoration of rocky shores, sandy beaches, tidal flats, and shallow subtidal bottoms impacted by oil spills; the effects of oil on seagrass ecosystems; the recovery and restoration of salt marshes and mangroves following an oil spill; measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil; oil spill damage and recovery in tundra and taiga; fisheries resource impacts from spills of oil or hazardous subtances; and a workshop summary.

W86-00239

RECOVERY AND RESTORATION OF ROCKY SHORES, SANDY BEACHES, TIDAL FLATS, AND SHALLOW SUBTIDAL BOTTOMS IM-PACTED BY OIL SPILLS, Stockholm Univ. (Sweden). Dept. of Zoology.

B. Ganning, D. J. Reish, and D. Straughan.

In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 7-36, 5 Fig, 5 Tab, 96 Ref.

Descriptors: *Oil spills, *Oil pollution, *Cleanup operations, *Ecological effects, *Literature re-views, *Water pollution effects, Aquatic orga-nisms, *Littoral environments, Tidal flats, Shores, Environmental effects. Intertidal areas.

A review of the literature on oil spills on rocky shores shows that the intertidal organisms in this type of environment exhibit considerable tolerance to oil pollution. Most damage from oil coating leads to suffocation or loss of attachment to the substrate. On sandy intertidal shores of tidal flats, the impact is increased by the persistence of oil in unconsolidated substrates. In subtidal sediment bottoms, the sensitivity to oil pollution is greater than in shallow sediment habitats since the organisms are living in fairly stable environments. Oil spill impact and effects of cleanup operations are more closely related to seawater temperatures than to latitude. Areas with large tidal amplitude suffer less from oil pollution than do low tidal or nontidal areas. Seasonality affects the impact of oil spills, especially when the spill takes place after reproduction and hatching. Areas having salinities dif-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C-Effects Of Pollution

fering from those of normal seawater suffer more stress when subjected to oil pollution due to increased inherent physiological stresses. For rocky shores, cleanup of oils by natural recovery processes is usually recommended. If mechanical removal of oil-contaminated sand is not feasible, then the polluted area should be left to natural recovery methods. Disposal of materials from cleanup operations is best done at oil refineries.

W86-00240

EFFECTS OF OIL ON SEAGRASS ECOSYS-

TEMS, Virginia Univ., Charlottesville. Dept. of Environ-

mental Sciences.

J. C. Zieman, R. Orth, R. C. Phillips, G. Thayer,

and A. Thorhaug.

In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 37-64, 5 Fig. 1

Descriptors: *Sea grasses, *Aquatic plants, *Ecosystems, *Oil spills, *Oil pollution, *Ecological effects, *Water pollution effects, *Cleanup operations, Fouling, Littoral zones, Environmental effects, Habitats, Dispersants, Toxicity, Intertidal areas, Literature reviews. areas. Literature reviews

A review of seagrass ecology is given to facilitate a discussion of the effects of oil spills on one of the most productive ecosystems known. Physically, seagrasses prevent erosion and stabilize the effects of tidal actions and provide habitats for numerous epiphytic organisms. Biologically, seagrasses perform an essential cycling of nutrients by absorbing P through the roots and leaves and returning both N and P to the water column from sediments via the plant Seagrass ecosystems can be damaged by N and P to the water column from secuments via the plant. Seagrass ecosystems can be damaged by oil through direct suffocation or fouling of orga-nisms or destruction of food sources or habitats. Oil pollution can affect the food market value of seagrass fisheries by tainting of flavor. Studies in the literature of major oil spills indicate that the greatest damage to aquatic organisms seems to be from aromatic hydrocarbon fractions of oil. The from aromatic hydrocarbon fractions of oil. The effects of oil dispersants on seagrass communities are not known. Inert absorbents present little hazard to seagrass systems if properly used. The normal recovery of seagrass systems from oiling depends on the extent of damage to sediments. Efforts of restoring oil-damaged seagrass systems by transplanting plugs or shoots have met with variable success. It is suggested that research be carried out on the toxicity levels of the major hydrocarbon substances on the major seagrass species in laboratory and field tests.

RECOVERY AND RESTORATION OF SALT MARSHES AND MANGROVES FOLLOWING AN OIL SPILL,

Research Planning Inst., Inc., Columbia, SC. C. D. Getter, G. Cintron, B. Dicks, R. R. Lewis,

and E. D. Seneca.

In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 65-113, 7 Fig, 4 Tab, 121 Ref.

Descriptors: *Mangrove swamps, *Marshes, *Oil spills, *Oil pollution, *Ecological effects, *Water pollution effects, *Cleanup operations, *Literature reviews, Wetlands, Dispersants, Ecosystems, Marsh plants, Swamps, Environmental effects.

Oil impacts to marshes will vary with amount of oil spilled, oil type, magnitude of cleanup activities, physical and biological structure of the marsh, latitude and season. Persistence of damage and recovery of the system depend on physical, chemical, and biotic factors such as weathering rate and degree of oil removal, availability of propagules, auccessional processes, sediment erosion/accretional degree of oil removal, availability of propagules, successional processes, sediment erosion/accretion, and restorative activities by man. Mangrove forests have different reactions to oil pollution, depending on mangrove types. Basin forests are already subjected to high natural stresses and may be more aensitive to additional stresses. If mangrove overwash islands are isolated from normal waves, they can be more severely damaged by the stranding of can be more severely damaged by the stranding of

oil in them. Most protective techniques are unlikely to damage marsh ecosystems, but the effects of oil-dispersant mixtures are not known. Foot and equipment traffic during cleanup of oil spills may produce adverse effects on marshes but not usually on mangroves. Techniques for restoring oiled marsh and mangrove areas include transplanting, fertilization, direct seeding, planting of propagules, seedlings or small trees. Research gaps include the effects of dispersants and herding compounds on marshes and mangroves, evaluation of cleanup techniques, studies on animal species of marshes and mangroves, follow-up studies of spill sites, growth of plants on oiled substrates and experimental restoration techniques. W86-00242

MEASUREMENTS OF DAMAGE, RECOVERY, AND REHABILITATION OF CORAL REEFS EXPOSED TO OIL, Continental Shelf Associates, Inc., Boulder, CO. K. W. Fucik, T. J. Bright, and K. S. Goodman. In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 115-133, 3 Fig, 2 Tab. 62 Ref.

Descriptors: *Coral reefs, *Oil spills, *Corals, *Oil pollution, *Dispersants, *Water pollution effects, *Ecological effects, *Cleanup operations, Environmental effects, Coelenterates, Oil recovery, Eco-

systems, Oil.

The Arabian Gulf and the Greater Caribbean are two well developed coral reef areas that receive much petroleum activity through the traffic of oil transporting tankers. Prespill mapping of coral reefs, a technique useful in the prevention and cleanup of oil spills, has been applied only to some reef areas. The sensitivity of reef ecosystems to oil spills is increased if the reef is of the emergent of shallow submergent type. Mechanized techniques such as skimmers do not cause oil to become incorporated into the water column. Currently available dispersants produce temporary stress reactions in corals in laboratory tests. Particulate sinking agents should be avoided in the cleanup oil spills near coral reefs. To assess the damage and recovery of coral reefs to oil pollution, studies at the organismal level should be conducted before community level impacts are examined. Difficulty arises in assessing the recovery of reefs from oil spills because little data exists for comparative purposes and recovery is a long term process. Reef rehabilitation may by transplanting coral planulae. More field studies are needed on the recovery after oil spills of complex coral reef systems. W86-00243 oil spills of complex coral reef systems. W86-00243

FISHERIES RESOURCE IMPACTS FROM SPILLS OF OIL OR HAZARDOUS SUBSTANCES,

Environmental Research Lab., Gulf Breeze, FL. W. P. Davis, D. E. Hoss, G. I. Scott, and P. F.

In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 157-172, 1 Tab,

Descriptors: *Oil spills, *Fisheries, *Environmental impact statement, *Oil pollution, *Water pollution effects, *Ecological effects, *Marine fisheries, *Economic aspects, Environmental effects, Fish, Toxicity, Oil, Fish stocking, Aromatic compounds, Cleanup operations, Shellfish.

Studies have shown that, in general, refined petroleum products are more toxic than crude oils to
marine organisms. The toxicity of aromatic hydrocarbons increases with increasing molecular size.
To protect identified fisheries from oil spills, shellsham be harvested in 'fenced off' areas or be
transferred to safer areas prior to contamination.
Attempts to obtain comparative assessments of impacts on fisheries have been made during a number
of oil spills by using such techniques as echo
sounding, species counting, aerial observations,
and grid sampling methods. In Japan, the help of
fishermen was enlisted when oil threatened a major
fishery. All catches were carefully monitored for fishery. All catches were carefully monitored for

contamination and economic damages were calcu-lated. Population restoration after oil spills can be accomplished by restocking. Areas that require further study are the relation of species or populaton stress to actual impact, use of dispersants, determination of recovery times, measurement techniques for sublethal effects and continued monitoring of spill areas to evaluate effectiveness of restoration efforts.

EFFEC'S, PATHWAYS, PROCESSES, AND TRANSFORMATION OF PUGET SOUND CONTAMINANTS OF CONCERN, E.V.S. Consultants Ltd., North Vancouver (British

Columbia). For primary bibliographic entry see Field 5B. W86-00293

ETHYLENE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS. Environmental Protection Service, Ottawa (Ontar-

August 1984. 58 p, 15 Fig, 6 Tab, 137 Ref.

Descriptors: *Water pollution effects, *Fate of pol-lutants, *Ethylene, *Hydrocarbons, *Chemical spills, *Spills, *Aquatic life, *Toxicity, *Water pol-lution prevention, Transportation, Lakes, Fishkill, Environmental effects, Pollutant identification, Chemical properties, Physical properties.

Information useful for designing countermeasures for ethylene spills and for assessing their effects on the environment includes a summary of pertinent data, chemical and physical properties, production and transportation, fate in the environment, toxicity to aquatic life and other organisms, suggested countermeasures, and analytical methods. When spilled into water, liquid ethylene simultaneously vaporizes and spreads on the surface. It is relatively insoluble in water. Nomograms are given for calculating rate of spreading on still water. The 4-day medium lethal toxicity rating for aquatic life is 1000 to 100 mg per liter. A fishkill is reported in fresh water at a concentration of 22-252 mg per liter and exposure of 1 hr. Ethylene disperses rapidly without bioaccumulation or food chain contamination potential. If necessary, ethylene-contaminated water may be aerated. Since chlorination in the presence of ethylene can form dichlorocthane, drinking water contaminated with ethylene should be aerated before chlorination.

W86-00303

5D. Waste Treatment Processes

EFFECTS ON GROUNDWATER QUALITY OF THE INTRODUCTION OF SECONDARY SEWAGE TREATMENT TO AN EFFLUENT RECHARGE SITE ON THE CHALK OF SOUTHERN ENGLAND, Water Research Centre, Marlow (England).

Journal of Hydrology, Vol. 77, p 333-359, 1985. 8 Fig, 7 Tab, 16 Ref. Commission of the European Commmunities contract ENV-399-UK(N).

Descriptors: *Groundwater contam ondary wastewater treatment, *Artificial recharge, *England, *Chalk aquifer, Wastewater disposal, Wastewater treatment, Effluent, Recharge, Fate of pollutants.

Detailed investigations were carried out at a site on the Chalk of southern England between 1978 and 1982 to determine the effects of sewage effluent recharge on groundwater quality. Before 1981 screened crude domestic sewage was recharged to the Chalk via a series of lagoons. During 1981 a secondary-treatment works was commissioned on the site and the effluent recharged through a new subsurface drain network. Monitoring of the inorganic, organic and microbiological quality of effluent and groundwater continued through the change-over, enabling the effects of the new regime to be assessed. The recharge of sewage effluent to groundwater was shown to be an effec-

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

tive way of ameliorating the effluent quality. Fol-lowing the introduction of secondary treatment at the site there seems to have been little change in the degree of contaminant removal. (Author's ab-W86-00043

WASTEWATER REUSE AND EXPOSURE TO LEGIONELLA ORGANISMS, Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab. For primary bibliographic entry see Field 5C. W86-00054

TOXIC ORGANICS REMOVAL KINETICS IN OVERLAND FLOW LAND TREATMENT, Cold Regions Research and Engineering Lab., Hanover, NH.
T. F. Jenkins, D. C. Leggett, L. V. Parker, and J.

L. Oliphant. Water Research, Vol. 19, No. 6, p 707-718, 1985. 4 Fig, 11 Tab, 32 Ref.

Descriptors: *Toxic substances, *Organic compounds, *Wastewater treatment, *Land treatment, *Overland flow, Water treatment, Volatilization, Adsorption, Sorption.

The efficiency in removing 13 trace organics from wastewater was studied on an outdoor, prototype overland flow land treatment system. More than 94% of each substance was removed at an application rate of 0.4 cm/h (0.12 cu m/h/m of width). The % removals declined as application rates were increased. Removal from solution was described by first-order kinetics. A model based on the two-film theory was developed using three properties of each substance (the Henry's constant, the octanol-water partition coefficient and the molecular weight) and two system parameters (average water depth and residence time). The dependence of the removal process on temperature was consistent removal process on temperature was consistent with the known dependence of Henry's constant and diffusivity on temperature. The model was tested on a second overland flow system. (Author's abstract) W86-00057

COMPUTER SIMULATION OF AN INDUSTRIAL WASTEWATER TREATMENT PROCESS, Montana Coll. of Mineral Science and Technology, Butte. Dept. of Chemistry and Geochemistry. D. R. Jenke, and F. E. Diebold.
Water Research, Vol. 19, No. 6, p 719-724, 1985. 1 Fig. 6 Tab, 7 Ref. U.S. Bureau of Mines grant J0295042.

Descriptors: *Computer models, *Wastewater treatment, *Industrial wastewater, Mixing, Lime, Acid mine drainage, Mine drainage, Acid streams, Chemical reactions.

The computer program REDEQLEPAK has been modified to allow for the prediction and simulation of the chemical effect of mixing two or more aqueous solutions and one or more solid phases. In this form the program is capable of modelling the lime neutralization treatment process for acid mine waters. In its present form, the program calculates the speciation of all influent solutions, evaluates the equilibrium composition of any mixed solution and provides the stoichiometry of the liquid and solid phases produced as a result of the mixing. The program is used to predict the optimum treatment effluent composition, to determine the amount of neutralizing agent (lime) required to produce this optimum composition and to provide information which defines the mechanism controlling the treatment process. (Author's abstract)

TOXICITY TO DAPHNIA OF THE END PRODUCTS OF WET OXIDATION OF PHENOL AND SUBSTITUTED PHENOLS, Michigan Technological Univ., Houghton. Dept. of Biological Sciences.

R. Keen, and C. R. Baillod.
Water Research, Vol. 19, No. 6, p 767-772, 1985. 6

Fig, 5 Tab, 12 Ref. EPA grant R805565-010.

Descriptors: *Toxicity, *Daphnia, *Water pollution effects, *Wet oxidation, *Phenols, Wastewater treatment, Oxidation, Bioassays, Water treatment.

The process of wet oxidation breaks down organic substances in aqueous solution at elevated temperatures and pressures. Experimental wet oxidations were carried out on pure solutions of phenol, 2-chlorophenol and 4-nitrophenol. After 1-h wet oxidation, final concentrations of these compounds averaged 3% of their concentrations in the starting solutions. The toxicities of the starting compounds and the residual toxicity of the end-product solutions were measured with 48-h acute toxicity tests using Danhinia magna. The solutions of end products of the product of the product solutions of the nons were measured with 48-n acute toxicity tests using Daphnia magna. The solutions of end products were all less toxic than the starting solutions by factors ranging from 10 to 120. However, the end-product solutions were somewhat more toxic than would be predicted from the known concentration of initial compound remaining in the solution of end products. (Author's abstract)

POINT SOURCES-NONPOINT SOURCES TRADING IN THE LAKE DILLON WATER-SHED.

Northwest Colorado Council of Governments, Frisco.

For primary bibliographic entry see Field 5B. W86-00167

DEPOSIT CONTROL TECHNOLOGY FOR KRAFT RECOVERY UNITS, New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources. H. N. Tran.

Environmental Protection Service, Ottawa, Ontar-io. Report EPS 3/PF/1, December 1984. 26 p, 21 Fig, 2 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Pulp and paper industry, *Kraft mills, *Pulp wastes, Bleaching wastes, Waste recovery, Automation, Monitoring, Economic aspects,

Models.

This report describes the development of an online instrument for measuring the rate of accumulation of fireside deposits in the superheater and boiler sections of kraft recovery units. The recovery unit eliminates the lignin and other wood components dissolved in the black liquor and recovers and regenerates the inorganic pulping chemicals while producing steam for power generation and process heating. Large accumulations of fireside deposits plug flue gas passages and ultimately limit kraft recovery unit capacity and pulp mill production. Sootprobe offers the opportunity for increased pulp production through improved deposit control. It is estimated that, in a nominal 750-ton/day kraft mill, the use of this technology would result in an incremental pulp production of \$26 million/yr, and an energy savings of \$200 thousand. Results of three trials of the research models of sootprobe at a kraft mill in Ontario show that the accumulation of deposits in the superheater and boiler bank regions in kraft recovery units can be continuously measured using sootprobe. The signal from sootprobe is reliable. Sootprobe can be used to monitor flue gas temperatures. Deposit accumulation rates in the superheater and boiler bank regions vary significantly at the same black liquor firing load. Sootprobe provides a feedback signal to the operator so that he can adjust firing conditions to minimize deposit accumulation rate. W86-00170

ENVIRONMENTAL ENGINEERING, Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering. For primary bibliographic entry see Field 5F. W36-00188

FLOW BALANCING METHOD FOR STORM-WATER AND COMBINED SEWER OVER-FLOW.
Studies Council for Building Research, Stock-

noun. Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124453. 1982. 27 p, 8 Fig. 5 Photos.

Descriptors: *Wastewater treatment, *Flow control, *Equalizing, *Lake restoration, *Storm wastewater, *Combined sewer overflows, Peak flow, Varied flow, Water pollution control, Runoff, Storm runoff, Overflow.

A low-cost flow balancing plant for storm water discharges and combined sewer overflows was demonstrated at Lake Trehorningen near Stockholm, Sweden. Floating tanks consisting of ponctions with reinforced vertically hanging plastic curtains are anchored to the bottom of the receiving water body. They operate as a horizontally working balancing system using the plug flow principle. The surrounding water functions as a balancing medium. When storm water discharge exceeds the pumping capacity of the treatment plant, the polluted storm water pushes the lake water from one floating tank compartment to the next in the flow direction. When storm water discharge is less than the pumping capacity of the treatment plant, the flow is reversed, allowing lake water to successively enter the floating tank compartments. During dry weather lake water may be pumped through the treatment plant to improve water quality. Experiences at three similar installations are described.

DEVELOPMENT DOCUMENT FOR EFFLU-ENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE TEXTILE MILLS POINT SOURCE CATEGORY.

Environmental Protection Agency, Washington, DC Effluent Guidelines Div. For primary bibliographic entry see Field 5G. W86-00207

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, AUGUST, 1981-OCTOBER, 1982: CITATIONS FROM THE NTIS DATA BASE.

nal Technical Information Service, Spring-National field, VA.

Available from the National Technical Information Sevice, Springfield, VA 22161 as PB83-801365. December 1982, 183 p.

Descriptors: *Mine wastes, *Bibliographies, *Oil shale, *Industrial wastes, *Wastewater treatment, *Water pollution control. *Water quality control, Gasification, Pollutant identification, Leachates, Shales, Environmental effects, Ecological effects, Coundwater, pollution, Streams, Water, require, Groundwater pollution, Streams, Water require-

This bibliography contains 183 abstracts of government-funded research on oil shale. Among the water-related subjects are water pollution control, waste and wastewater characterization and treatment, leachates, effect on groundwater and streamwater quality, environmental and ecological impacts of wastes, water requirements, social and economic impacts, and hydrological aspects. All these entries are new since the last edition. W86-00215

NEW CONCEPTS AND PRACTICES IN ACTIVATED SLUDGE PROCESS CONTROL, Arthur Technology, Inc., Fond du Lac, WI. R. M. Arthur.

Activated Sludge Process Control Series, Ann Arbor Science, Ann Arbor, MI. 1982. 125 p.

Descriptors: *Wastewater treatment, *Activated sludge, *Biological wastewater treatment, *Monitoring, *Process control, *Activated sludge process, *Aeration, *Mixed liquor solids, Sludge, Suspended solids, Denitrification, Control systems,

Process control in the wastewater treatment plant is the responsibility of the plant operator. The engineer aids the plant operator in his job by

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

designing a plant which has the flexibility and controllability needed to produce high quality effluents. On-line instrumentation provides the basis for process control. In conventional plug flow activated sludge plant, aeration, return of settled sludge, and mixed liquor suspended solids are controllable elements. Conventional activated sludge systems can be modified by contact stabilization, extended aeration, and use of pure oxygen. Control methods may be manual or of the microprocessor, computer control or adaptive control types. Control modes available are on-off controls, ratio control, proportional control, proportional plus integral control, and proportional plus derivative control. The four measurements of the biological system important in process control include progress of metabolism, the state of denitrification, the concentration of viable microorganisms and the aerobic-anaerobic stage of respiration. The sensors that are available to monitor these factors are discussed along with various control schemes for the activated dudge arecests. discussed along with various control schemes for the activated sludge process.

CHEMICALS AND WETLANDS, For primary bibliographic entry see Field 5C. W86-00233

MODELING OF AN ANFLOW MUNICIPAL MODELING OF AN ANTOW MUNICIPAL WASTE-TREATMENT UNIT, Massachusetts Inst. of Tech., Oak Ridge, TN. School of Chemical Engineering Practice. D. J. Halbert, and R. J. Wojtowicz. D. J. Halbert, and R. J. Wojtowicz. Available from the National Technical Information Service, Springfield, VA 22161 as DE82-16617. ORNL/MIT-342, June 1982. 65 p, 10 Fig, 7 Tab, 21 Ref, Contract/Grant No. W-7405-eng-26.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Model studies, Biological wastewater treatment, ANFLOW reactor, Computer programs, Methane, Kinetics, Upflow reactor.

A computer program, ANFLOW.F4, was written to model the anaerobic upflow, or ANFLOW bioreactor, developed in the Chemical Technology Division at Oak Ridge National Laboratory. The program predicts sludge accumulation rates, effluent liquid composition, and effluent gas flow rate and composition as a function of time following a change in inlet flow rate or composition. The and composition as a function of time following a change in inlet flow rate or composition. The model can be used to qualitatively study ANFLOW behavior. The ANFLOW reactor was modeled as a settling tank and a series of continuous stirred-tank reactors (CSTR). Residence-time distribution experiments on the uninoculated column indicate that it is best modeled by two to column indicate that it is best modeled by two to five CSTRs in series. The number of CSTRs was left as an input parameter in the computer pro-gram. A reaction scheme based on conversion of soluble chemical oxygen demand first to volatile acids by acetogenic bacteria and then to methane and carbon dioxide by methanogenic bacteria was selected. Monod and inhibition kinetics were used for acetogenesis and methanogenesis respectively. selected. Monog and infinition kinetics were used for acctogenesis and methanogenesis, respectively. Material balances were written for 14 components in each CSTR. Kinetic and equilibrium constants were extracted from the literature, and a numerical integration technique was used to solve the time dependent steady-state solutions of the material balances. The program was successfully tested for one CSTR. (Author) W86-00246

EVALUATION OF THE LECTRO CLEAR Z' ELECTROCOAGULATION PROCESS FOR MEAT PACKING WASTEWATER TREAT-MENT.

Western Industrial Labs. Ltd., Edmonton (Alber-

Report No. EPS 4-WP-82-1, January 1982. Environmental Protection Service, Ottawa, Ontario. 92 p, 4 Fig, 4 Tab, 4 Append.

Descriptors: *Wastewater treatment, *Meat processing industry, *Flotation, Lectro Clear Z unit, Industrial wastewater, Biological wastewater treat-

The Lectro Clear Z unit is used to pretreat wastes from a meat packing plant in Lethbridge, Alberta.

The unit's basic principle is formation of a floc by adjustment of the wastewater pH to 4.0-4.5 with sulfuric acid or sodium hydroxide, addition of chemical, and electrolysis to form hydrogen and oxygen. The gas bubbles float the floc to the surface where it is skimmed. Average BOD in the surface where it is skimmed. Average BOD in the influent wastewater is 647 mg per liter; average effluent, 284 mg per liter, with a removal of 50%-70%. Suspended solids removals are 68%, from an average of 522 to 173 mg per liter.

W86-00252

ANNOTATED BIBLIOGRAPHY ON NORTH-ERN ENVIRONMENTAL ENGINEERING, 1978-1979,

ental Protection Service. Ottawa (Ontario). Water Pollution Control Directorate.
For primary bibliographic entry see Field 10C.
W86-00289

5E. Ultimate Disposal Of Wastes

SEAWATER CIRCULATION IN SEWAGE OUT-

FALL TUNNELS, New South Wales Univ., Kensington (Australia). Water Research Lab. D. L. Wilkinson.

Journal of Hydraulic Engineering, Vol. 111, No. 5, p 846-857, May, 1985. 6 Fig, 1 Tab, 3 Ref.

Descriptors: *Seawater, *Saline water intrusion, *Wastewater outfall, *Outfall tunnels, Tunnels, Design criteria, Wastewater disposal, Model stud-

As a means of maintaining water quality along the foreshores, sewage wastes at certain sites have been conveyed offshore through tunnels excavated beneath the sea floor and released into the ocean through a series of vertical shafts or risers. The risers are typically 2 to 5 km offshore. The failure of the outfalls at Aberdeen (Scotland) and Weyworth (England) to function as originally legisland. mouth (England) to function as originally planned has been attributed to the intrusion of seawater into nas been attributed to the intrusion of seawater into the outfall tunnel. Model studies showed that the dense seawater can form a wedge structure in the tunnel which completely blocks the sewage discharge from the more seaward risers; seawater circulates through the more seaward risers to be discharged into the ocean through the riser located immediately above the wedge. A different mode of blocking called circulation blocking occurs when seawater is drawn down the more shoreward risers and a mixture of sewage and seawater discharges from the seaward risers. The magnitude of the circulation was determined in terms of the sewage flow and geometric parameters of the outfall. An expression was derived for the sewage flow required to arrest the circulation. Circulation blocked outfalls will clear when the sewage inflow exceeds a critical flow rate; however, like wedge blocked outfalls, the flow required to achieve is many times greater than the flow needed to prevent intrusion into the diffuser ports. Tunnelled ocean outfalls should be constructed with the design capacity discharge required to purge an outfall subject to circulation blocking. (Collier-IVI) the outfall tunnel. Model studies showed that the IVI) W86-00017

DIGITAL SIMULATION OF THE REGIONAL EFFECTS OF SUBSURFACE INJECTION OF LIQUID WASTE NEAR PENSACOLA, FLORI-

Geological Survey, Tallahassee, FL. Water Resources Div. For primary bibliographic entry see Field 5B. W86-00122

FOR CONTAMINATION OF POTENTIAL FOR CUNIAMINATION OF SHALLOW AQUIFERS IN ILLINOIS, Illinois State Geological Survey Div., Champaign. R. C. Berg, J. P. Kempton, and K. Cartwright. Circular 532, 1984. 30 p, 12 Fig, 2 Tab, 2 Plates, 40

Descriptors: *Aquifers, *Waste disposal, *Geological mapping, *Groundwater pollution, *Illinois,

Mapping, Geohydrology, Geological surveys, Municipal wastes, Solid waste disposal, Underground ste disposal.

The potential for contaminating groundwater resources is a critical concern in Illinois. Contaminawastes and surface concern in Illinois. Contamination may result from land burial of municipal
wastes and surface or near-surface disposal of
wastes. Aquifers are susceptible to contamination
because their hydrogeologic properties allow
waste effluents to travel rapidly. Whether a shallow aquifer actually becomes contaminated also
depends on the properties of the earth/geologic
materials that surround it. The purpose of this
project was to describe and map geologic materials
to a depth of 50 ft throughout the state of Illinois.
The combination of hydrogeologic properties and
stratigraphic position of geologic materials provides the basis for mapping the potential for contaminating aquifers. Two maps constructed for this
study show the distribution of sequences of geologic materials and their comparative ratings. Each
sequence was rated for the susceptibility of its
water-yielding materials (aquifers) to contamination from waste-disposal practices. The maps are
presented at a scale of 1:500,000 for the entire state.

They may be used for suggesting areas where
disposal of wastes will have surious particulation. tion may result from land burial of municipal presented at a scale of 1:500,000 for the entire state. They may be used for suggesting areas where disposal of wastes will have minimum potential for contaminating groundwater resources and for screening areas with low contamination potential as part of the process of locating new disposal W86-00178

MODIFICATION OF BELL CANYON TEST

(BCT) 1-FF GROUT,
Army Engineer Waterways Experiment Station,
Vicksburg, MS. Structures Lab. For primary bibliographic entry see Field 8G. W86-00248

5F. Water Treatment and **Quality Alteration**

ADVANTAGES OF DISSOLVED-AIR FLOTA-TION FOR WATER TREATMENT,

Water Research Centre, Stevenage (England) T. Zabel.

American Water Works Association, Vol. 77, No. 5, p 42-46, May, 1985. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Dissolved-air flotation, *Water treatment, *Physicochemical treatment, Design criteria, Algae, Sedimentation, Flocculation, Coagulation, Turbidity, Softness.

Many raw water sources contain low-density particles such as algae, which, because of their tendency to float, cause problems in the sedimentation stage. In particular, nutrient-rich stored waters that may contain heavy algae blooms are difficult to treat by sedimentation. In addition, treatment of low turbidity, soft, highly colored waters produces very light flocs that settle very slowly. Dissolvedair flotation as a primary clarification stage for the production of potable water is particularly effective for the treatment of these waters. Dissolvedair flotation plants consist of a facility to mix the coagulation chemicals with the raw water and a mechanical flocculation stage, followed by a flotation tank. Part of the treated water is recycled, pressurized, and saturated with air and then introduced to the flocculated water stream via a bank of air injection nozzles. The pressure is reduced to air injection nozzles. The pressure is reduced to atmospheric pressure across the nozzles thus re-leasing the air in the form of fine bubbles. The air bubbles attach themselves to the flocs and the bubbles attach themselves to the flocs and the bubble-floc agglomerates rise to the surface of the flotation tank and are removed as floated sludge either by flooding or mechanical scraping. Flotation has several process advantages over sedimentation: It can produce better water quality; it can be operated at high surface loadings, resulting in relatively small and shallow plants; and it can be started up quickly, with a steady water quality being achieved within 45 min. Also, the solids concentration of the sludge produced is significantly higher (about 3 percent) than that of sludge produced by sedimentation. Detailed information

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration—Group 5F

is given on the design of flocculation and flotation tanks, the air saturation system, the production of microbubbles, and the different sludge removal systems that can be used. Performance data are given for flotation plants used for clarification of several raw waters, with special emphasis on the treament of algae-laden waters and iow-turbidity, highly colored waters. (Collier-IVI) W86-00005

REMOVING BARIUM AND RADIUM THROUGH CALCIUM CATION EXCHANGE, CH2M Hill, Milwaukee, WI.
A. G. Myers, V. L. Snoeyink, and D. W. Snyder.
Journal of the American Water Works Association, Vol. 77, No. 5, p 60-66, May, 1985. 11 Fig, 5
Tab, 14 Ref. EPA contract CR-808912.

Descriptors: *Barium, *Radium, *Cation exchange, *Water treatment, Drinking water, Groundwater treatment, Ion exchange.

The removal of barium and radium, which are found in many groundwater sources, was achieved in laboratory studies with an ion exchange process. A strong acid resin in the Ca form achieved excellent removal of Ba(2+) and Ra(2+) from water containing 15-30 mg Ba(2+)/L and 43 pCi Ra-226/L. The resin was regenerated easily with CaCl2 brine, and after repeated exhaustion-regeneration cycles using reclaimed brine, the only water quality change observed during the production cycle was the reduction of the Ba(2+) and Ra-226 concentrations. Total hardness, alkalinity, pH, and other parameters were essentially unpH, and other parameters were essentially un-changed. Operation of this column in parallel with a strong acid, Na-form column will enable the production of water that meets the standards for Ba and Ra and has the hardness desired for distri-bution. The capacity of the virgin Ca-form column and Ra and has the hardness desired for distribution. The capacity of the virgin Ca-form column for Ba(2+) was approximately 75 mg Ba(2+)/g form. The capacity of the virgin Ca-form column for Ba(2+) was approximately 75 mg Ba(2+)/l resin (Ca form). The capacity of the column after several exhaustion-regeneration cycles depends on the dosage of regenerant. The CaCl2 regenerant concentration of 0.85M was significantly more effective at a given dosage than higher (1.69M) or lower (0.42M) concentrations. The spent CaCl2 brine can be reclaimed for reuse. The brine reclamation process should significantly reduce the brine disposal problem, but ways of disposing of the precipitates must be found, and the cost involved in using the process must be established. (Baker-IVI) W86-00008

AWWA SURVEY OF INORGANIC CONTAMI-NANTS IN WATER SUPPLIES. Journal of the American Water Works Associa-tion, Vol. 77, No. 5, p 67-72, May, 1985. 12 Fig. 5

Descriptors: *Drinking water, *Quality control, *United States, *Surveys, *Inorganic compounds, Nitrates, Sulfates, Regulations, Arsenic, Fluoride, Barium, Lead, Selenium, Cadmium, Mercury,

Chromium, Silver.

Results of a survey of the United States and its territories on the frequency and extent of inorganic contaminants in drinking water supplies are reported as prepared by AWWA's Inorganic Contaminants Committee, Water Quality Division. Data are presented on the inorganic contaminants listed in the US EPA primary and secondary drinking water regulations. Thirty-nine states responded to the survey with 37 providing data. Problems with meeting the primary inorganic maximum contaminant levels (MCLs) are most common in small communities served by surface water (1.6%). High nitrate concentrations were the primary reason for inactivating wells or systems that were reported to have been shut down. High fluoride was the next most frequently reported reason. Response data were scarce on systems that had been shut down. In terms of frequency only, the main difficulties in meeting the primary MCLs were a result of fluoride, nitrate and to a much lesser extent, selenium, arsenic, barium, and lead contamination. Geographic distribution patterns are clear for the oc-

currences of excessive nitrate, selenium, barium and arsenic. Ninety percent of the excess fluoride and nitrate-N occurrences were less than 5.0 mg/L and 20.0 mg/L, respectively. The remaining 10% still represent a significant number of water supplies. Twenty-six states responded with actual or estimated data on the secondary inorganic contaminants. If these data are linearly extrapolated for all 50 states, there are about 28,000 occurrences of contaminants in excess of the secondary McNs. The most common secondary MCL contaminants are iron, manganese, and dissolved solids. Sulfates, chloride, and color are also quite significant. (Baker-IVI) chloride, as (Baker-IVI) W86-00009

IN-HOME TREATMENT METHODS FOR RE-MOVING VOLATILE ORGANIC CHEMICALS, Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div. R. K. Sorrell, E. M. Daly, M. J. Weisner, and H. J. Brass.

Journal of the American Water Works Association, Vol. 77, No. 5, p 72-78, May, 1985. 6 Fig, 13 Tab, 13 Ref.

Descriptors: *Volatile compounds, *Organic compounds, *Drinking water, *Water treatment, Boiling, Electric mixing, Aeration.

The effectiveness of six in-home treatment methods for removing volatile organic chemicals (VOCs) from drinking water was investigated. At least two methods appeared excellent for temporary use in emergency situations. Bolling and electric mixing afforded about 100% removal of the test compounds (chloroform, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethylene, bromoform, tetrachloroethylene, t-butyl methyl ether, benzene, ethylbenzene, m-xylene, and m-dichlorobenzene) using ordinary kitchen appliances, in phase 1. Phase 1 of the testing involved six methods - boiling, electric mixing, open standing, aerbenzene) using ordinary kitchen appliances, in phase 1. Phase 1 of the testing involved six methods - boiling, electric mixing, open standing, aeration, pouring and faucet aeration. The first four methods were reexamined in phase 2, during which VOC loss over time was monitored. Loss of VOCs by boiling was found to be variable. This variability was likely due to the lower heating efficiency of the household stove which made it difficult to determine the start of boiling. The estimated cost per month of treating water by boiling for a family of four would be about \$4.70. Electric mixing provided excellent removal of boiling for a family of four would be about \$4.70. Electric mixing provided excellent removal of VOCs in phases I and 2. The estimated cost to a household was about \$0.30 per month using this method. A third method, open standing, provided reasonable removal without any significant compound bias. However, the length of treatment required, 48-72 hr, is excessive. Aeration was less effective and very compound dependent. While the risk of inhaling volatile organic chemicals evolved from water is basically unknown, it may be of a similar magnitude to that of ingesting water containing such chemicals, if very large volumes are being treated. This risk is also involved in such activities as cooking, showering, bathing, and using humidifiers and vaporizers. (Baker-IVI)

REMOVAL BY COAGULATION OF TRACE ORGANICS FROM MISSISSIPPI RIVER

WATER, Minnesota Univ., Minneapolis. Dept. of Civil and

Minnesota Univ., Minneapolis. Dept. of CIVII and Mining Engineering.
M. J. Semmens, and K. Ayers.
Journal of the American Water Works Association, Vol. 77, No. 5, p 79-84, May, 1985. 15 Fig, 4 Tab, 26 Ref. EPA grant CR806377.

Descriptors: *Mississippi River, *Organic compounds, *Water treatment, *Coagulation, Salicylic acid, Acidity, Trace compounds, Octanoic acid, Phenols, Benzoic acid, Organic matter.

Studies were conducted on the removal of four truly soluble, low-molecular weight model compounds (octanoic acid, phenol, benzoic acid, and salicylic acid) by coagulation with alum and iron salts. The model compounds were generally poorly removed by coagulation. The extent of removal was weakly dependent on coagulant dosage except

for salicylic acid, which showed improved removal at higher dosages in the presence of natural organics. Removal of the model organic compounds was generally better in the absence of natural organic matter. Percentage removals of the model organic compounds were similar to the re-movals of the <1K molecular weight fraction of movals of the <1K molecular weight fraction of the natural organic matter. The pH influenced the removal of compounds containing a phenolic-OH functional group but did not influence those con-taining only carboxylic acid functional groups. Co-agulation removed intermediate and high molecu-lar weight organic compounds (1-10K and 10-100K) most effectively. Removal of the model organic compounds by coagulants appeared to result from complex formation and precipitation, with the soluble metal-organic complexes formed at the low concentration (about 8 x 10 to the minus 7th power) tested limiting the extent of removal. 7th power) tested limiting the extent of removal. Simple adsorption does not appear to be a significant mechanism of removal under the conditions tested. (Baker-IVI)

EFFECTS ON GROUNDWATER QUALITY OF THE INTRODUCTION OF SECONDARY SEWAGE TREATMENT TO AN EFFLUENT RECHARGE SITE ON THE CHALK OF SOUTHERN ENGLAND,

Water Research Centre, Marlow (England). For primary bibliographic entry see Field 5D. W86-00043

FATE OF ALDICARB, ALDICARB SULFOXIDE, AND ALDICARB SULFONE IN FLORIDAN GROUNDWATER,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.

For primary bibliographic entry see Field 5B. W86-00045

RAINWATER CATCHMENT WATER QUALITY IN MICRONESIA,

Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 3B. W86-00061

COMPARATIVE EFFECTIVENESS OF ANTI-FOULING TREATMENT REGIMES USING CHLORINE OR A SLOW-RELEASING BRO-MINE BIOCIDE.

Rensselaer Polytechnic Inst., Troy, NY. Dept. of R. J. Soracco, E. W. Wilde, L. A. Mayack, and D.

H. Pope. Water Research, Vol. 19, No. 6, p 763-766, 1985. 2 Fig. 9 Ref.

Descriptors: *Fouling, *Antifouling, *Chlorine, *Biocides, *Bromine biocides, Heat exchangers, Water treatment, Cooling water, Pesticides, Indus-

Five chlorine (Cl2) and three slow-releasing bromine biocide (1-bromo-3-chloro-5,5-dimethylhydantoin (BCDMH)) treatment regimes were compared under laboratory conditions to determine pared under laboratory conditions to determine their effectiveness in controlling the fouling of 304L stainless steel heat exchanger tubing. The most effective Cl2 treatments were low level (0.1 ppm or less) continuous applications. Three intermittent Cl2 treatments (1 h/day at 1.0 ppm, 1 h/day at 0.5 ppm, and 3 x 20 min/day at 0.5 ppm) were about equally effective. However, all three intermittent versions were significantly less effective. intermittent regimes were significantly less effective than the low level continuous treatments. The ctiveness of BCDMH treatment was similar to C12 when used intermittently at similar residual concentrations at C12 for 1 h/day and continuously at low levels. These experiments indicated that low level continuous treatment was more effective than intermittent treatment for controlling biofouling. W86-00063

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F-Water Treatment and Quality Alteration

INACTIVATION OF NAEGLERIA GRUBERI CYSTS BY CHLORINE DIOXIDE, Ohio State Univ., Columbus. Dept. of Civil Engi-

Y. S. R. Chen, O. J. Sproul, and A. J. Rubin. Water Research, Vol. 19, No. 6, p 783-789, 1985. 6 Fig. 4 Tab, 27 Ref. U.S. EPA Office of Explorato-ry Research grant R808150-02-0.

Descriptors: *Naegleria, *Protozoans, *Chlorine dioxide, *Water treatment, *Cysts, Hydrogen ion concentration, Water temperature, Disinfection, Ozonation, Poliovirus, Viruses.

The kinetics of chlorine dioxide inactivation of The kinetics of chlorine dioxide mactivation of Naegleria gruberi cysts (a nonpathogenic soil and water protozoan closely related to the human parasite N. fowleri) were investigated as were the influence of pH from 5 to 9, temperature from 5 to 30 C, cyst age from 3 to 12 days, and cyst clumping. Survivals were obtained for each study as a function of time at several chlorine dioxide concentrations. Inactivation was characterized by an initial concave downward shoulder followed by an essentially linear portion but the process obeved initial concave downward shoulder followed by an essentially linear portion but the process obeyed Watson's Law. At 25 C and pH 7 the mean concentration time product for 99% inactivation was 5.5 mg x min/l. These products varied inversely with temperature and pH. The mean concentration time product for 99% inactivation roughly doubles for each 10 C size is the truster temperature. The time product for 99% inactivation roughly doubles for each 10 C rise in the water temperature. The actual ratios were 1.6 between 5 and 1.5 C and 1.7 between 15 and 25 C. Ozone has the lowest time-concentration products followed in order by chlorine dioxide and chlorine. Ozone is distinctly the better disinfectant under lower temperature and at pH's of 8 or less. At a pH of 9 and at 25 C chlorine dioxide approaches ozone in effectiveness. Chlorine, at pH's above 7, rapidly loses its effectiveness as the hypochlorous acid ionizes to the hypochlorous roughly in the New English of the Statistical Workship of the Statistical Statistical Workship of the Workship rite ion. The N. gruberi cyst is distinctly more difficult to inactivate than poliovirus 1 but on the same order as bacterial spores. (Collier-IVI)

OPTIMAL URBAN WATER DISTRIBUTION DESIGN,

DESIGN, MacLaren Engineers, Winnipeg (Manitoba). D. R. Morgan, and I. C. Goulter. Water Resources Research, Vol. 21, No. 5, p 642-652, May, 1985. 7 Fig. 9 Tab, 19 Ref.

Descriptors: *Linear programming, *Water conveyance, *Hardy-Cross network solver technique, Cost analysis, Economic factors, Model studies,

An iterative procedure capable of analyzing both layout and design of new systems and expansion of existing systems has been developed. One of the major advantages of the technique is that it ensures hydraulic consistency in each of the networks considered during the iterative procedure. In the design of new systems a wide range of loading patterns and pipe failure combinations can be considered. The manner in which the large number of constraints associated with all possible load combinations is reduced to a manageable size does not permit a claim for global optimality. The procedure must therefore be classified as heuristic. The results obtained by the procedure show that it is capable of efficiently producing economical solutions. The method has been demonstrated as being applicable to the layout and design of a network of capable of efficiently producing economical solutions. The method has been demonstrated as being applicable to the layout and design of a network of 2 sources, 20 nodes, and 37 links, and the expansion of an existing network. Comparison of the results produced by this procedure for a network expansion problem with the results of previous studies for the same problem shows that this procedure produces an inexpensive solution in an efficient manner. The procedure is relatively simple, being based on two widely available and accepted techniques, the Hardy-Cross Network solver and linear programming operations research technique. The ability of the model to use the very efficient simplex algorithm of the linear programming makes the procedure applicable to large systems. The method also utilizes realistic and easily accessible pipe cost functions using standard cost data, i.e., pipe cost functions using standard cost data, i.e., cost per unit length. (Baker-IVI)
W86-00071

CHEMISTRY FOR OPERATORS,

Muskegon County Board, MI. Dept. of Public

Works.
R. L. Fountain.
Water Treatment Plant Operation Series, Volume
4, Ann Arbor Science, Ann Arbor, MI. 1982.
Edited by V. W. Langworthy. 148 p.

Descriptors: *Chemical reactions, *Reviews, *Wastewater treatment, Chlorination, Alkalinity, Coagulation, Flocculation, Phosphorus removal, Water softening, Nitrogen.

This book was written to provide the operators of water and wastewater treatment plants with a basic course in chemical theory and the chemical reactions that occur at such facilities. The first eight tons that occur at such ratemets. The first eight chapters cover basic theory and principles essential to all chemical reactions. The remaining chapters deal with chlorination, alkalinity, coagulation and flocculation, water softening, and phosphorus and nitrogen removal. Each chapter concludes with a set of problems and their solutions. The chapter on chlorination explains oxidation-reduction reactions, chlorination explains oxidation-reduction reactions, reactions with impurities, breakpoint chlorination, and the determination of chloride residuals. The chapter on alkalinity discusses the determination of alkalinity. The causes of turbidity and color are discussed in the chapter on coagulation and flocculation, along with the control of coagulation, the jar test, and zeta potential. The lime-soda process and the ion exchange process are considered in the chapter on water softening. In the chapter on phosphorus and nitrogen removal, nitrogen removal by biological nitrification-dentrification, breakpoint chlorination, selective ion exchange, and air stripping of ammonia is considered.

W86-00134

HYDRAULICS FOR OPERATORS, Michigan Dept. of Public Health, Lansing. Section of Water Supply. For primary bibliographic entry see Field 8B. W86-00135

ENVIRONMENTAL ENGINEERING, Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering. P. A. Vesilind, and J. J. Peirce. Butterworth, Boston. 1982. 602 p.

Descriptors: *Water treatment, *Wastewater treatment, *Water analysis, *Water pollution sources, *Water pollution effects, *Public health, *Sludgetreatment, water pointion energy, rubine feath, Studge treatment, *Sludge disposal, Nonpoint source pollution, *Water law, Radioactive wastes, *Water supply, *Water distribution, *Sewers, Biodegradation, Wastewater characteristics, Environmental effects, Landfills.

A textbook on environmental engineering is organized in five major areas: water resources, air quality, solid and hazardous wastes, noise, and environmental impact. Water-related topics include water pollution, measurement of water quality, water supply and transmission, water treatment methods, wastewater collection and treatment, sludge treatment and disposal, nonpoint source water pollution and its control, water pollution law, landfills, and environmental impact and assessment. ment. W86-00188

5G. Water Quality Control

SEAWATER CIRCULATION IN SEWAGE OUT. FALL TUNNELS, New South Wales Univ., Kensington (Australia). Water Research Lab. For primary bibliographic entry see Field 5E. W86-00017

HYPOLIMNETIC AERATION: PRACTICAL DESIGN AND APPLICATION, British Columbia Ministry of Environment, Vancouver. Fisheries Research and Technical Services

K. I. Ashley.

Water Research, Vol. 19, No. 6, p 735-740, 1985. 23 Ref, 1 Append. NRC grant 67-3454.

Descriptors: *Aeration, *Hypolimnetic aeration, *Lake restoration, *Fisheries managment, Destratification, Design criteria, Oxygenation.

Hypolimnetic aeration is becoming increasingly important as a fisheries management and water quality improvement technique, however its application has been restricted by a paucity of practical reference material. Hypolimnetic aeration includes partial and full lift designs and several air/oxygen injection systems. Positive displacement compressors flanged to three phase electric motors are the preferred air supply and power for most lake aeration projects. Internal combustion power is adequate for short term use and wind power is in the developmental stage. Rubber compressed air hose is recommended for lake aeration applications. Free air delivery is the air volume taken into the compressor at standard temperature and pressure however actual output volume is regulated by discharge pressure. Performance specifications of full lift hypolimnetic aerators are based on water-air ratios, oxygen increase, transfer efficiencies and oxygenation capacity. An empirical sizing method was developed using hypolimnetic volume, hypolimnetic oxygen consumption, water flow, air flow and inflow tube radius. Outflow tube radius should equal or exceed inflow tube radius to achieve high flow rates and allow efficient removal of residual bubbles. Floatation requirements were calculated from the total weight of the separator box, inflow and outflow tubes and the theoretical water head. (Author's abstract) ration is becoming increa

RELEASE OF ENDOTHALL FROM AQUATHOL GRANULAR AQUATIC HERBI-

North Texas State Univ., Denton. Dept. of Biolog-

icai Sciences.
K. H. Reinert, S. Stewart, M. L. Hinman, J. H.
Rogers, Jr., and T. H. Leslie.
Water Research, Vol. 19, No. 6, p 805-808, 1985. 3
Fig, 3 Tab, 21 Ref.

Descriptors: *Herbicides, *Fate of pollutants, *Endothall, *Aquatic plants, *Pesticide kinetics, Kinetics, Fish, Sunfish, Water pollution effects.

The release rate kinetics of endothall from Aquathol Granular Aquatic Herbicide (Aquathol) were determined in two static shake flask tests and the release half-life was determined from the release rate. A zero-order release rate of 1.58 mg//h and a half-life of 5.06 h were calculated from the replicate studies. These experiments about the and a half-life of 5.06 h were calculated from the replicate studies. These experiments show that Aquathol releases endothall relatively rapidly in a static environment; however, this release would be expected to be faster in a dynamic aquatic system such as a reservoir where horizontal dispersion and dilution can occur. The release rate, when coupled with the fate processes affecting endothall persistence in aqueous systems and the relatively high endothall concentration required for acute toxicity to non-target organisms such as bluegill sunfish (428 mg/l), make Aquathol a candidate for control of nuisance aquatic vegetation where water usages are critical. (Collier-IVI)

APPLICATION OF THE STORM MODEL TO DESIGN PROBLEMS IN SINGAPORE AND IN KAOSIUNG, REPUBLIC OF CHINA,

Camp, Dresser and McKee, Inc., Boston, MA. For primary bibliographic entry see Field 6A. W86-00086

MIXING ZONE MODEL FOR CONSERVA-TIVE PARAMETERS, Oklahoma Water Resources Board, Oklahoma

City. M. R. Hutcheson In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 65-86, 11 Fig. 1 Tab, 12 Ref. Descriptors: *Model studies, *Waste load, *Mixing, Water quality, *Water quality managment, *Mathematical studies, *Water quality anagment, *Numerical analysis, Models, Nonpoint pollution sources, Wastewater disposal, Water quality control, Industrial wastes.

The development of a wasteload allocation process which incorporates a numerical solution to the dispersion equation is described. The methodology relies on simplification of the dispersion equation through the use of assumptions so that it may be solved numerically. Then a relationship between the standard deviation of a Gaussian distribution and the dispersion coefficient is devived. A relationship for the standard deviation, hence the dispersion coefficient is developed based on hydrology and plume dimensions. The dispersion equation is solved numerically for pollutant concentration at grid points throughout the mixing zone. The maximum concentration at the end of the mixing zone, the related source strength, the background concentration and the water quality standard are used to determine the wasteload allocation which will protect the water quality standard. This process is applicable to multiple discharges as well as isolated ones, using the superposition principle. The methodology was applied to an industrial point source (Farmland Industries) that discharges into Skeleton Creek. It was demonstrated that the dispersion model can predict concentration distributions well enough to develop permit limits which will allow water quality standards in a receiving stream to be met.

W86-00089 The development of a wasteload allocation proces W86-00089

SOME RECENT ADAPTATIONS AND APPLICATIONS OF QUAL-II IN THE NORTHEAST, For primary bibliographic entry see Field 5B. W86-00090

REVIEW OF MODEL USE IN EVALUATING NONPOINT SOURCE LOADS FROM FOREST MANAGEMENT ACTIVITIES, National Council of the Paper Industry for Air and Stream Improvement Inc., New York. For primary bibliographic entry see Field 5B. W86-00031

MECHANISTIC SIMULATION FOR TRANS-PORT OF NONPOINT SOURCE POLLUT-ANTS Simons, Li and Associates, Inc., Fort Collins, CO. For primary bibliographic entry see Field 5B. W86-00092

PLANNING AND IMPLEMENTATION OF RE-GIONAL STORMWATER MANAGEMENT FA-CILITIES IN MONTGOMERY COUNTY,

MARYLAND,
Greenhorne and O'Mara, Inc., Riverdale, MD.
For primary bibliographic entry see Field 4A.
W86-0009

NUTRIENT INPUT FROM THE LOXAHAT-CHEE RIVER ENVIRONMENTAL CONTROL CHEE RIVER ENVIRONMENTAL CONTROL
DISTRICT SEWAGE-TREATMENT PLANT TO
THE LOXAHATCHEE RIVER ESTUARY,
SOUTHEASTERN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.

For primary bibliographic entry see Field 5B. W86-00110

NATIONAL WATER SUMMARY 1983-HY-DROLOGIC EVENTS AND ISSUES, Geological Survey, Reston, VA. Water Resources

For primary bibliographic entry see Field 6B. W86-00131

ECONOMIC PERSPECTIVES ON ACID DEPO-

SITION CONTROL.

Acid Precipitation Series, Volume 8, Butterworth
Publishers, Boston, 1984. Volume edited by
Thomas D. Crocker. Series edited by John I. Teas-

ley. 180 p.

Descriptors: *Water quality control, *Acid rain, *Air pollution, Precipitation, *Economic aspects, Policy making, Fate of pollutants, Fisheries, Decision making, Cost analysis, Model studies, Legal aspects, Canada.

Papers on the economic aspects of acid aspects of acid deposition control are grouped into five general topics: (1) policy perspectives (the current level of scientific knowledge relative to possible control decisions), (2) economic benefits of control (dose-response estimation, economic damages to the Adirondack fisheries, and economic damages from a Canadian perspective), (3) international aspects (legal, economic, and political aspects of transfrontier pollution), (4) economically optimal control strategies, and (5) economic caveats.

W86-00136

ACID RAIN: DOES SCIENCE DICTATE POLICY OR POLICY DICTATE SCIENCE, Georgia Univ., Athens. Inst. of Natural Resources. For primary bibliographic entry see Field 6E. W86-00137

EFFECT OF GLOBAL OPTIMIZATION ON LOCALLY OPTIMAL POLLUTION CONTROL: ACID RAIN, West Virginia Univ., Morgantown. Dept. of Eco-For primary bibliographic entry see Field 6C. W86-00138

ECONOMICALLY RELEVANT RESPONSE ES-TIMATION AND THE VALUE OF INFORMA-TION: ACID DEPOSITION, Oregon State Univ., Corvallis. Dept. of Agricul-tural Economics. tural Economics.

For primary bibliographic entry see Field 6B.

W86-00139

SCIENTIFIC TRUTHS AND POLICY TRUTHS IN ACID DEPOSITION RESEARCH, Wyoming Univ., Laramie. Dept. of Economics. For primary bibliographic entry see Field 6B. W86-00140

NORMATIVE ECONOMICS AND THE ACID RAIN PROBLEM, Oklahoma Univ., Norman. Div. of Economics. For primary bibliographic entry see Field 6B. W86-00141

ECONOMIC IMPACT OF ACID PRECIPITA-TION: A CANADIAN PERSPECTIVE, Oklahoma Univ., Norman. Div. of Economics. For primary bibliographic entry see Field 6C. W86-00142.

LEGAL, ETHICAL, ECONOMIC AND POLITI-CAL ASPECTS OF TRANSFRONTIER POLLU-TION,

Resources for the Future, Inc., Washington, DC. For primary bibliographic entry see Field 6E. W86-00143

ACIDIFICATION IMPACT ON FISHERIES: SUBSTITUTION AND THE VALUATION OF RECREATION RESOURCES, Clarkson Univ., Potsdam, NY. Dept. of Econom-

ics. F. C. Menz, and J. K. Mullen.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 135-155, 3 Fig. 6 Tab, 44 Ref.

Descriptors: *Water pollution effects, *Cost analysis, *Acid rain, *Fisheries, Precipitation, Air pollution, Economic aspects, Adirondack Mountains, New York, Lake fisheries, Stream fisheries, Recreation, Model studies.

Water Quality Control—Group 5G

Economic losses to anglers in the Adirondack recreational fishery resulting from acidification damage were estimated at \$1.7-3.2 million, depending on assumptions pertaining to habitat loss and substitution by anglers among fisheries. These were considered lower-bound estimates for the following reasons: (1) estimates were based only on licensed New York resident anglers fishing in waters open to public fishing, (2) they were based on the assumption that information concerning the effect of acidification on alternative fishing sites is known and accurately perceived by the angling population, (3) estimates of currently perceived damages may understate future damages if acidification is irreversible, and (4) results of this study pertained only to the currently observable effects of acidification on a limited portion of the Adirondack recreational fishery. W86-00144

TRANSFERABLE DISCHARGE PERMITS AND PROFIT-MAXIMIZING BEHAVIOR

Wyoming Univ., Laramie. Dept. of Ecor J. T. Tschirhart.

J. 1. 1 Schirnart.
III: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 157-171, 3 Fig, 14 Ref, 1 Append.

Descriptors: *Water quality control, *Acid rain, *Air pollution, Water pollution control, Permits, Economic aspects, Transferable discharge permits, Precipitation, Profit, Regulations.

A model of a profit-maximizing firm was presented where the firm confronts an emission standard and has the options to either install scrubbers or enter into transferable discharge permit (TDP) markets. The results of the model characterize how the firm chooses among the options to meet the standard at minimum cost. However, the driving force behind the minimum cost solution is that the firm is a profit maximizer. There are situations where this may not be an appropriate assumption. For inthe minimum cost solution is that the firm is a profit maximizer. There are situations where this may not be an appropriate assumption. For instance, in regulated industries where constraints on profits are invoked by government commissions, the minimum cost solution is not attained. A bias toward overutilization of scrubbers is possible. Even in nonregulated industries, however, there are plausible reasons why firms do not maximize profit, including uncertainty, organization complexity and alternative goals. All of this is not to say that TDP markets should be abandoned. Instead, this chapter contains a number of pitfalls that regulators should be aware of when implementing TDP markets. How important these pitfalls are is an empirical question that cannot be answered until the market are allowed to operate for some time. Until then, control agencies should closely observe those firms that may be candidates for these pitfalls, particularly those in regulated industries. And if their behavior deviated from that outlined above, adjustments in the TDP system are in order. (Author)

TECHNIQUES TO REDUCE THE SEDIMENT RESUSPENSION CAUSED BY DREDGING,

Army Engineer Waterways Experime Vicksburg, MS. Environmental Lab. G. L. Raymond. Miscellaneous Paper HL-84-3. Senten

Miscellaneous Paper HL-84-3, September 1984. Final Report. 33 p, 14 Fig, 15 Ref.

Descriptors: *Suspended solids, *Dredging, *Suspended sediments, *Ecological effects, Bottom sediments, Dredges, Turbidity, Reviews, Fluvial sediments, Marine sediments, Design criteria, Polychlorinated biphenyls, Water resources development (Changal investment)

As part of a larger effort under the Improvement of Operation and Maintenance Techniques Proof Operation and Maintenance Techniques Pro-gram to develop a method to predict the extent of sediment resuspension and contaminant release when dredging in contaminated sediments, the U. S. Army Engineer Waterways Experiment Sta-tion's Water Resources Engineering Group is con-ducting field studies to evaluate new and existing

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

dredging methods. The level of sediment resuspended by a given dredge type in a given sediment was examined using various operational parameters. Results of the first 2 yr of study which rameters. Results of the first 2 yr of study which included field work and extensive literature reviews show that different dredge types produce different amounts of suspended sediment in different parts of the water column. Resuspensions caused by cutterhead and hopper dredges tend to remain in the lower water column, while bucket dredges increase resuspensions throughout the water columns. The amount of resuspension caused by a given dredge type also depends on the operating techniques used with the dredge. Sediment resuspension can be lessened by changing operating techniques, as in the case of the cutterhead, or by modifying the equipment, such as enclosing a clamabell bucket. Special purpose dredges can also be used to reduce sediment resuspension, but their lower production rates limit their application.

W86-00159

POTENTIAL FOR CONTAMINATION OF SHALLOW AQUIFERS IN ILLINOIS, Illinois State Geological Survey Div., Champaign. For primary bibliographic entry see Field 5E. W86-00178

SORPTION BEHAVIOUR OF 14C IN GROUNDWATER/ROCK AND IN GROUND-WATER/CONCRETE ENVIRONMENTS, Seakem Oceanography Ltd., Sidney (British Co-For primary bibliographic entry see Field 5B. W86-00184

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, 1978-JULY, 1981: CITATIONS FROM THE NTIS DATA BASE. National Technical Information Service, Spring

For primary bibliographic entry see Field 4C. W86-00201

DEVELOPMENT DOCUMENT FOR EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE TEXTILE MILLS POINT SOURCE CATEGORY.

POINT SOURCE CATEGORY.

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div. Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116871.

EPA 440/1-82/022, September 1982. Final Report. 509 p, 11 Fig. 152 Tab, 238 Ref, 1 Append.

Descriptors: "Water quality control, "Wastewater treatment, "Textile mill wastes, "Industrial wastes, "Standards, "Effluent limitations, "Water pollution sources, "Wastewater composition, Water pollution control, Water use, Water reuse, Water conservation, Conservation, Chemical wastes, Wool, Biological wastewater treatment, Process control.

Textile manufacturing facilities were studied to develop effluent limitations for existing point sources, standards of performance for new sources, and pretreatment standards for existing and new sources. The industry was divided into several subsects of the property week opening the facilities and the standard of the several subsects of the several subsects of the several subsects and the several subsects of t and pretreatment standards for existing and new sources. The industry was divided into several subcategories: wool scouring, wool finishing, low water use processing, woven fabric finishing, knit fabric finishing, carpet finishing, stock and yarn finishing, nonwoven manufacturing, and felted fabric processing. Raw wastewater characteristics vary widely among the categories and also within each category, depending on raw materials and process control. Of 123 toxic pollutants, only 22 were not present or suspected to be present in textile mill wastewaters. Data are listed for analyses of toxic pollutants in the water supply and in treated effluents. The following wastewater constituents were designated as subject to limitation under BPT, BAT and NSPS as appropriate: BOD, total suspended solids, pH, total chromium, COD, phenols, and sulfide. In-plant controls and process changes suitable for pollution control include water reuse, water use reduction, chemical substitution, and material reclamation. Available wastewater treatment technologies are described in detail.

W86-00207

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, AUGUST, 1981-OCTOBER, 1982: CITATIONS FROM THE NTIS DATA BASE.

National Technical Information Service, Spring-field, VA. For primary bibliographic entry see Field 5D. W86-00215

RESTORATION OF HABITATS IMPACTED BY OIL SPILLS. For primary bibliographic entry see Field 5C. W86-00239

RECOVERY AND RESTORATION OF ROCKY SHORES, SANDY BEACHES, TIDAL FLATS, AND SHALLOW SUBTIDAL BOTTOMS IM-

PACTED BY OIL SPILLS, Stockholm Univ. (Sweden). Dept. of Zoology. For primary bibliographic entry see Field 5C. W86-0024

EFFECTS OF OIL ON SEAGRASS ECOSYS-

TEMS, Virginia Univ., Charlottesville. Dept. of Environ-mental Sciences. For primary bibliographic entry see Field 5C. W86-00241

RECOVERY AND RESTORATION OF SALT MARSHES AND MANGROVES FOLLOWING AN OIL SPILL, Research Planning Inst., Inc., Columbia, SC. For primary bibliographic entry see Field 5C. W86-00242

MEASUREMENTS OF DAMAGE, RECOVERY, AND REHABILITATION OF CORAL REEFS EXPOSED TO OIL, Continental Shelf Associates, Inc., Boulder, CO. For primary bibliographic entry see Field 5C. W86-00243

FISHERIES RESOURCE IMPACTS FROM SPILLS OF OIL OR HAZARDOUS SUB-

Environmental Research Lab., Gulf Breeze, FL. For primary bibliographic entry see Field 5C. W86-00244

LEACHATE FROM HAZARDOUS WASTES

STTES, New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering. For primary bibliographic entry see Field 5B. W86-00247

PLANNING GUIDE FOR EVALUATING AGRI-CULTURAL NONPOINT SOURCE WATER QUALITY CONTROLS, Cornell Univ., Ithaca, NY. P. D. Robillard, M. F. Walter, and L. M.

Brucaner. EPA-600/3-82-021, September 1982. Environmen-tal Research Laboratory, Athens, GA. 733 p, 33 Fig, 22 Tab, 23 Refs, 6 Append. Contract/Grant No. R804925010.

Descriptors: *Water quality control, *Water pollution sources, *Fate of pollutants, *Agriculture, *Nonpoint pollution sources, Planning, Pollution load, Nitrogen, Phosphorus, Sediment, Animal wastes, Salinity, Nutrients, Farm management, Farm wastes, Insecticides, Pesticides, Fertilizers, Lirigation, Eutrophication, Soil conservation, Sediment transport, Erosion control, Cover crops, Terracing, Economic aspects, Honey Creek, Ohio, Yakima River, Washington, Cornell Nutrient Simulation Model, Model studies.

This is a manual for evaluation and selection of agricultural nonpoint source controls for irrigated

and nonirrigated cropland. The methodology ap-plies to areas ranging in size from an individual farm to a large region. Agricultural practices and their impacts on water quality are described. Pol-lutants of concern are nitrogen, phosphorus, sedi-ment, animal wastes, and salinity. Pollution control nutants of concern are nitrogen, phosphorus, sediment, animal wastes, and salinity. Pollution control measures involving tillage methods, cropping practices, and methods of fertilizer and pesticide application are divided into three groups: structural, vegetative, and managerial. The evaluation methodology consists of several steps: (1) description of the watershed, (2) identification of the problem, (3) determination of applicable control measures, (4) choice of the unit of analysis, (5) establishment of the base condition, (6) evaluation of control measures, and (7) development of an optimal control strategy. The methodology is demonstrated with two examples: an individual farm in the Yakima River basin, Washington, and the Honey Creek, Ohio, watershed. The six appendixes, comprising 600 pages of the manual, concern sediment and nutrient loadings from nonirrigated croplands, sediment and nutrient loss from irrigated agriculture, salinity control, water quality problems relatives. ture, salinity control, water quality problems related to animal agriculture, insecticide use, and economic perspectives of nonpoint source water qualent. W86-00260

WINTER EVALUATION OF OIL SKIMMERS AND BOOMS

Environmental Protection Service, Ottawa (Ontar-

Report EPS 4-EP-84-1, February 1984. 109 p, 39 Fig, 17 Tab, 7 Ref, 3 Append.

Descriptors: *Water quality control, *Water pollution control, *Oil recovery, *Cleanup, Oil skimmers, Booms, Oil spills, Little Giant, Destroil, Slicklicker, Skim-Pak, Morris MT-80, Arctic Skimmer, Arctic Marine Oilspill Program, Zoom Boom, Albany Oilfence, Troilboom, Vikoma Seapack, Cold regions.

Five mechanical oil recovery devices (skimmers) Five mechanical oil recovery devices (skimmers) and six oil containment barriers were evaluated in Newfoundland and Nova Scotia during Marchapril 1980. The skimmers varied in size, collection principle, and intended application. Specific comments were given for each. However, some general conclusions were drawn. Only the Destroil and Versatech Arctic Skimmer were deemed capable of surviving moderate sea conditions. Although they can recover a wide range of oils, they would they can recover a wide range of oils, they would have difficult processing cold Bunker C directly from the water's surface. The Skim-Pak was con-From the water's surface. In extiminate water surface, it is extended to result of convergence of the surface o as a Bunker C recovery device. The Morris MI-80, as presently designed, proved to be too complicated. The U.S. Coast Guard boom proved durable, well designed, and of high quality construction. The AMOP and Zoom booms effectively contained oil; the length of the lower tension member was an important factor. All booms tested were strong enough and durable enough to handle realistic loads. W86-00290

EUROPEAN AND UNITED STATES CASE STUDIES IN APPLICATION OF THE CREAMS

International Inst. for Applied Systems Analysis, Laxenburg (Austria). For primary bibliographic entry see Field 5B. W86-00294

CREAMS: A SYSTEM FOR EVALUATING MANAGEMENT PRACTICES ON FIELD-SIZE AREAS,

Agricultural Research Service, Tifton, GA. South-east Watershed Research Center. For primary bibliographic entry see Field 5B. W86-00295

Evaluation Process—Group 6B

TESTING THE APPLICATION OF CREAMS TO FINNISH CONDITIONS, National Board of Waters, Helsinki (Finland). For primary bibliographic entry see Field 5B. W86-00296

ENVIRONMENTAL EFFECTS OF NITROGEN FERTILIZATION EXEMPLIFIED BY GROUNDWATER POLLUTION AS SIMULATED BY CREAMS,

Goettingen Univ. (Germany, F.R.). For primary bibliographic entry see Field 5B. W86-00297

APPLICATION OF THE CREAMS MODEL FOR CALCULATION OF LEACHING OF NI-TRATE FROM LIGHT SOILS IN THE NOTEC RIVER VALLEY, Institute for Land Reclamation and Grassland Farming, Raszyn (Poland). For primary bibliographic entry see Field 5B. W86-00298

APPLICATION OF THE CREAMS MODEL: WESTERN SKANE, SWEDEN, Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 5B.
W86-00299

PREDICTING HILLSLOPE RUNOFF AND EROSION IN THE UNITED KINGDOM: PRE-LIMINARY TRIALS WITH THE CREAMS

MODEL, National Coll. of Agricultural Engineering, Silsoe (England). For primary bibliographic entry see Field 5B. W86-00300

APPLICATION OF THE CREAMS MODEL AS PART OF AN OVERALL SYSTEM FOR OPTI-MIZING ENVIRONMENTAL MANAGEMENT IN LITHUANIA, USSR: FIRST EXPERIMENTS, Lithuanian Research Inst. of Forestry, Vilnius (USSR): For primary bibliographic entry see Field 5B. W86-00301

REVIEW OF CASE STUDIES OF CREAMS MODEL APPLICATION, Agricultural Research Service, Tifton, GA. South-east Watershed Research Center. For primary bibliographic entry see Field 5B. W86-00302

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

DYNAMIC MODEL FOR MULTIRESERVOIR

DYNAMIC MUDEL FOR A CALIFORNIA CALIFORNIA Univ., Davis. Dept. of Land, Air and Water Resources.

M. A. Marino, and H. A. Loaiciga.
Water Resources Research, Vol. 21, No. 5, p 619-630, May, 1985. 8 Fig. 5 Tab, 29 Ref. University of California, Water Resources Center project

Descriptors: *Model studies, *Reservoir operation, *Operating policies, *Central Valley Project, *California, Planning, Management planning, Hy-droelectric power, Electric power production.

A methodology to obtain optimal reservoir operation policies for a large-scale reservoir system was developed. The model yields medium-term (one-year-ahead) optimal release policies that allow the planning of activities within the current water year, with the possibility of updating preplanned activities to account for uncertain events that affect the state of the system. River flows are characterized as a multivariate autoregressive

process and are forecasted using maximum likelihood estimators. The solution method is a sequential dynamic decomposition algorithm that keeps computational requirements and dimensionality problems at low levels. The model maximizes the system annual energy generation while satisfying constraints imposed on the operation of the reservoir network. Several alternative versions of the model con be seen to see the second of the operation of the second of the operation of the second of the se voir network. Several alternative versions of the model can be used under different assumptions. The model was applied to a large-scale multireservoir system, the northern portion of the California Central Valley Project. The optimal release policies show a potential increase in the system total annual energy with respect to heuristic schedules currently in use. (Author's abstract) W86-00069

QUADRATIC MODEL FOR RESERVOIR MANAGEMENT: APPLICATION TO THE CENTRAL VALLEY PROJECT, California Univ., Davis. Dept. of Land, Air and Water Resources. M. A. Marino, and H. A. Loaiciga. Water Resources Research, Vol. 21, No. 5, p 631-641, May, 1985. 4 Fig. 3 Tab, 6 Ref.

Descriptors: *Reservoir operation, *Central Valley Project, *California, *Model studies, *Quadratic models, Optimization, Planning, Water management, Reservoir releases, Hydroelectric power.

ment, Reservoir releases, Hydroelectric power.

A quadratic optimization model is applied to the Central Valley Project in California to obtain operation schedules. The model has the minimum possible dimensionality, treates spillage and penstock releases as decision variables and takes advantage of system-dependent features to reduce the size of the decision space. The quadratic optimization model was compared with a linear model. Both models lead to a potential increase in the annual energy production, as was demonstrated for a water year of average streamflow conditions. The quadratic model showed that the Sacramento-San Joaquin Valley agricultural water deliveries can be increased by adopting the optimal release policies. This suggests the possibility of expanding irrigated areas, providing better leaching of agricultural fields, and improving conjunctive management of surface and groundwater reservoirs. Although the release policies computed by the quadratic and linear models were similar, there are reasons for preferring the quadratic model. First, it leads to problems of lower dimensionality and provides a closer representation of the physical features of the system, particularly with regard to nonlinearities in the objective function and constraints. Second, because of its capability to incorporate spillages explicitly, the quadratic model can handle a reservoir system of more complicated configuration and complex mass balance equation. (Baker-IVI)

APPLICATION OF THE STORM MODEL TO DESIGN PROBLEMS IN SINGAPORE AND IN KAOSIUNG, REPUBLIC OF CHINA, Camp, Dresser and McKee, Inc., Boston, MA.

Camp, Dresser and McRee, and, B. M. Harley.
In: Proceedings of Stormwater and Water Quality Model Users Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 22-42, 11 Fig.

Descriptors: *Model studies, *Project planning, *Design criteria, *Urban runoff, *Developing countries, *Water supply development, *Sewer systems, Storm runoff, Hydrologic models, Simulation analysis, Wastewater treatment.

Two examples of the application of modified versions of the STORM model are presented. The first application involved a study in Singapore where urban stormwater runoff was to be captured and treated to augment the island's water supply. The STORM model was used to evaluate the basin runoff, to size the diversion/storage/pumping facilities, and to help determine the effective safe yield from the proposed project. The STORM model also enabled the design team to evaluate the effectiveness of the many quantity and quality control options which should be considered during

project development. The second application of the STORM model was in the development of design strategies to control heavily contaminated combined sewer overflows to the Jen Ai River of Kaohsiung, Republic of China. The design study was for a series of major combined sewer overflow structures which, in conjunction with a single trunk sewer, will reduce BOD loadings on the river by over 90%. Use was made of the model's ability to simulate the effect of storage and local treatment at each of the control facilities. These two examples demonstrate that models such as STORM can be effectively used in design situations in developing countries.

W86-00086

ATTEMPT TO IMPLEMENT SWMM IN TUNI-SIA, Lund Univ. (Sweden).

J. Niemczynowicz.
In: Proceedings of Stormwater and Water Quality
Model User Group Meeting, January 27-28, 1983,
University of Florida, Gainesville. p 43-52, 7 Fig, 5

Descriptors: *Model studies, *Rainfall-runoff relationships, *Hydrologic models, *Urban runoff, *Storm runoff, *Storm water, *Computer models, *Hydrographs, Runoff, Storm sewers, Management planning, Urban hydrology.

To aid the city of Tunis in stormwater management, a cooperative project was undertaken by the Universities of Lund and Tunis to apply the Storm Water Management Model (SWMM) to the city's problems. The project also sought to teach local research personnel how to handle the model. In order to obtain input data for model calibration, rainfall and runoff data from the Guereb-Roriche catchment which covers about 20 sq km, was used. Significant differences between Swedish and Tunisan urban areas coupled with climatic differences caused significant differences in the input parameters of the model. Also a lack of understanding of the 'modeling philosophy' and a lack of trained hydrologists who knew how to run the computer further complicated the use of the SWMM. Despite these problems, it was possible to reproduce the observed hydrographs quite well as long as the areal distribution of rainfall was taken into account. To aid the city of Tunis in stormwater may W86,00087

MODELING WATER DEMANDS. For primary bibliographic entry see Field 6D. W86-00270

6B. Evaluation Process

CONDENSED DISAGGREGATION MODEL FOR INCORPORATING PARAMETER UNCERTAINTY INTO MOUTHLY RESERVOIR SIMULATIONS, Cornell Univ., Ithaca, NY. Dept. of Environmen-

Cornell Univ., Ithaca, NY. Dept. of Environtial Engineering.
For primary bibliographic entry see Field 2E.
W86-00073

NATIONAL WATER SUMMARY 1983-HY-DROLOGIC EVENTS AND ISSUES, Geological Survey, Reston, VA. Water Resources

Div. Available from Supt. of Documents, GPO, Washington, D.C. 20402. USGS Water-Supply Paper 2250, 1984. 243 p, 26 Fig, 9 Tab.

Descriptors: *National water assessment, *United States, *State water issues, *Hydrologic events, Water availability, Water quality, Hydrologic hazards, Land use, Institutional arrangements, Water

This national summary reviews current hydrologic and provides a broad overview of the hydrologic issues facing the Nation. The summary also includes a description of water issues for each State, the District of Columbia, Puerto Rico, the U.S.

Field 6—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

Virgin Islands, and the Western Pacific Islands under the jurisdiction of the United States. The State water-issue summaries were prepared by U.S. Geological Survey personnel in each of the States and are based on discussions with more than 130 State and local organizations. Taken together, these State summaries indicate the major similarities and differences in water issues facing different parts of the country. Major issues described include (1) the short-term vulnerability of surfacewater supplies and shallow ground-water supplies to drought; (2) concerns about the reliability of water supplies as competition for water increases; (3) declining ground-water levels; (4) control of surface-water pollution, especially nonpoint sources of pollution; (5) contamination of ground-water supplies and the mitigation of existing sources of pollution, such as hazardous-waste sites; (6) the potential effects of acidic precipitation; (7) sources of pollution, such as hazardous-waste sites;
(6) the potential effects of acidic precipitation; (7)
chronic problems of flooding; (8) the impacts of
resource development, such as coal mining and
low-head hydropower, on water resources; and (9)
the development of water allocation and reallocation procedures. Hydrologic perspectives on these
issues are discussed under the headings 'Water
availability'; Water quality'; 'Hydrologic hazards
and land use'; and 'Institutional and management'.
(ISCS) W86-00131

ECONOMIC PERSPECTIVES ON ACID DEPO-SITION CONTROL.

For primary bibliographic entry see Field 5G. W86-00136

ECONOMICALLY RELEVANT RESPONSE ES-TIMATION AND THE VALUE OF INFORMA-TION: ACID DEPOSITION, Oregon State Univ., Corvallis. Dept. of Agricul-tural Economics.

tural Economics.

R. M. Adams, and T. D. Crocker.

IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley, p 35-64, 5 Tab, 37 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, *Water pollution effects, Precipitation, Economic aspects, Model studies, Mathematical models, Water pollution control, Sulfur oxides, Agriculture, Decision making, Policy making, Regulations, Water quality control.

The response of ecosystems to acid deposition and the applicability of such response measures to eco-nomic assessments were reviewed, and a decision theoretic framework was developed. The methods theoretic framework was developed. The methods were applied to an agricultural problem using corn, soybeans, and cotton as examples. A numerical example compared four increasingly stringent regulatory policies from no standard (ambient oxidant standard of 0.18 ppm) to 0.08 ppm. Results were considered highly conditional. Any similar empirical assessment of response estimates would benefit from more comprehensive treatment of the economics of commodity demand and supply and better cost data, as well as a more complete statement of the decision making process of regulatory entities. entities. W86-00139

SCIENTIFIC TRUTHS AND POLICY TRUTHS IN ACID DEPOSITION RESEARCH,

Wyoming Univ., Laramie. Dept. of Economics. T. D. Crocker.

III. Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 65-79, 36 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, Precipitation, *Water quality control, Economic aspects, Social aspects, Policy making.

The tradeoff of one set of socially nonoptimal biases in emitter and receptor behavior against another set implies that the total social costs of acid depositions may be nonmonotonic in the com-

bination of the receptors' share of a realized environmental impact and in the critical values policy-makers and researchers use to reject or to fail to makers and researchers use to reject or to fail to reject hypotheses about cause-effect of source-cause linkages. For example, if emitters know they will be made responsible for only a minor portion of the cost consequences of a realized environmental impact, a relatively coarse test for failing to reject either of the aforementioned linkages may have less total social cost than does a more discriminatless total social cost than does a more discriminating test; the lesser emitter responsibility generates fewer emitter costs, while the less stringent critical values favor receptors. All this presumes that emitters and receptors perceive their interactions with the policymaker as being contingent on less-than-complete policymaker knowledge of cause-effect and source-cause linkages. The policymaker's choices of target levels for environmental response and emission controls, and the receptors', share and emission controls, and the receptors' share directly influence emitter and receptor incentives and thus the total social costs of their activities. In and thus the total social costs of their activities. In a stochastic world in which emitters do not have to bear the full cost consequences of their activi-ties, scientifically less-than-ideal hypothesis test procedures can desirably alter emitter and receptor investment incentives. Very lenient criteria for fail-ing to reject the results on environmental impacts ing to reject use results on environmental impacts embodied in scientific reports can reduce the total social costs of acid deposition and their control. This result in no way depends on costly information acquisition for control costs or environmental

NORMATIVE ECONOMICS AND THE ACID RAIN PROBLEM,

Oklahoma Univ., Norman. Div. of Economics. L. S. Eubanks, and R. A. Cabe.

IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, But-terworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 81-96, 17 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollu-tion, Precipitation, Economic aspects, Water pollu-tion control, Decision making, Policy, Water qual-ity control, *Normative economics, Alternative planning, Planning, Legal aspects, Philosophy.

The scope of normative economics is limited in a way that excludes arguments that favor or oppose specific criteria for judging optimality. Politicians and philosophers are regarded to have expertise to make such arguments. It is unfortunate that standard securities of normative according to the latest of securities according to the latest of the securities according to the sec make such arguments. It is unfortunate that standard practice of normative economics is almost eclusively associated with the study of only one criterion, the efficiency criterion. The implication of this is that normative economics as practiced has a very limited normative basis. This conclusion is illustrated clearly when a number of contributions to the philosophy literature are examined. It is not suggested that normative economics is of little use in policymaking, only that the self-delimited scope of normative economics should be understood in its proper perspective. The practice of normative economics has not been entirely true to its traditional definition because it is seldom interested in the study of criteria posing as alternatives to the tonal definition occase it is sensor interested in the study of criteria posing as alternatives to the criterion of efficiency. Certainly there is an enor-mous amount of interesting normative economic analysis, as traditionally defined, concerning alteranalysis, as traditionally defined, concerning alter-native normative criteria. Normative economic analysis certainly has relevance to policymaking with respect to environmental problems such as acid rain, but perhaps only if it remains true to its defined scope and allocates its effort to the analysis of a much larger set of criteria for evaluating desirable resource uses. (Author) W86-00141

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER UTILITY OPERATING DATA: AN ANALYSIS,

Ames, IA.

For primary bibliographic entry see Field 6D. W86-00004

EFFECT OF GLOBAL OPTIMIZATION ON LOCALLY OPTIMAL POLLUTION CONTROL:

West Virginia Univ., Morgantown. Dept. of Economics.

S. Atkins

IN: Acid Precipitation Series, Volume 8: Econor ic Perspectives on Acid Deposition Control, But-terworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley, p 21-33, 5 Tab, 11 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollu-tion, *Water quality control, Precipitation, Eco-nomic aspects, Model studies, Mathematical models, Water pollution control, Sulfur oxides, Ambient least-cost control, State Implementation Plans, Fate of pollutants, Cuyahoga County, Cleveland, Ohio.

The use of ambient least-cost systems (ALC) offered substantial savings over the State Implementation Plans (SIP) in attaining compliance with ambient air quality standards with respect to acid emissions from powerplants. Using data on a set of 5 sulfur dioxide sources in Cuyahoga County in the Cleveland region of the Ohio River Basin, mathematical modeling showed that the substantial cost savings of the ALC strategy over the SIP strategy (about \$14 million) was largely due to the long-range transport of locally generated sulfur dioxide. When constraints on sulfur oxide transport were introduced, the cost savings (about \$2.5 million) of the ALC strategy were almost neutralized. The question was raised whether the remaining differential was substantial enough to cover the additional administrative costs of the ALC system and outweigh concerns about equity losses. The use of ambient least-cost systems (ALC) ofand outweigh concerns about equity losses.

ECONOMIC IMPACT OF ACID PRECIPITA-TION: A CANADIAN PERSPECTIVE.

Oklahoma Univ., Norman. Div. of Econo

IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 97-121, 3 Fig, 2 Tab, 49 Ref.

Descriptors: *Water pollution effects, *Acid rain, *Air pollution, Precipitation, *Economic aspects, Ontario, Canada, Lakes, Fishing, Recreation,

Taxes.

This paper reviews (1) economic theory relevant to controlling transboundary air pollution and (2) knowledge on the dose-response relationship between acid deposition and physical impacts in the natural environment. This is related to the potential economic significance of acid deposition in eastern Canada. In agriculture and forestry the available dose-response information is insufficiently conclusive to estimate monetary values with confidence. Aquatic effects of acid deposition are better understood than most other effects. In Ontario 48,000 lakes are considered sensitive to acidification, which could impact sport fishing, an important component in the province's tourism and recreation industry. Intangible aspects of the environment may also be affected. The increased uptake of mercury by fish in acidified waters also poses a health risk to persons who consume these fish. A survey of taxpayers' willingness to pay additional taxes to improve the environment at different levels is as yet incomplete. This uses 10 levels of environmental conditions rather, than different levels is as yet incomplete. This uses 10 levels of environmental conditions rather than dollar amounts of damages.

W86-00142

ACIDIFICATION IMPACT ON FISHERIES: SUBSTITUTION AND THE VALUATION OF RECREATION RESOURCES,

Clarkson Univ., Potsdam, NY. Dept. of Econom-

For primary bibliographic entry see Field 5G.

WATER RESOURCES PLANNING-Field 6

Water Demand—Group 6D

TRANSFERABLE DISCHARGE PERMITS AND PROFIT-MAXIMIZING BEHAVIOR, Wyoming Univ., Laramie. Dept. of Economics. For primary bibliographic entry see Field 5G. W86-00145

6D. Water Demand

WATER UTILITY OPERATING DATA: AN ANALYSIS,

Ames, IA. H. F. Seidel

Journal of American Water Works Association, Vol. 77, No. 5, p 34-41, May, 1985. 1 Fig. 12 Tab,

Descriptors: *Utilities, *Surveys, Water demand, Water distribution, Municipal water, Costs, Rural

Tha analyses of data gathered in AWWA surveys in 1976, 1978, and 1980 are simple - consisting primarily of means, medians, and frequency distributions for common water utility parameters. Water use in gallons per capita per day (liters per capita per day) was on a stable plateau from 1970 to 1980, with mean and median values of about 160 and 150 gpcd (606 and 568 L/d per capita), respectively. Analysis of rural water districts as a separate class was made possible for the first time by their increased participation in the 1980 survey. Their per-capita water use was somewhat less than that of similar municipal utilities, whereas their rates were from one third higher to double, depending on the size of the rural district. For municipal utilities, water rates essentially doubled from 1970 to 1980, but this was still not enough to keep up with inflation during the decade. (Author's abstract) W86.00004

PUBLIC WATER SUPPLIES IN GLOUCESTER

COUNTY, N.J.,
Army Engineer Waterways Experiment Station,
Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2F.
W36-00174

PRESENT AND PROSPECTIVE USE OF WATER BY THE MANUFACTURING INDUSTRIES OF NEW JERSEY, Illinois State Geological Survey Div., Champaign. M. Grossman, and A. L. Sherman.

Water Resources Circular 11, June 14, 1963. 12 p, 1 Tab. 5 Exhibits.

Descriptors: *Water demand, *Water use, *Population dynamics, *New Jersey, *Future planning, Water requirements, Human population, Surveys, Water resources development.

water resources development.

The industries of New Jersey are increasing their use of publically supplied water. Planning for water requirements at least 20 yr in advance of actual need is recommended. In order to obtain, record and report data concerning water use by industry, a procedural manual should be prepared containing questionnaires for industries and managers of public supplies. A study of water use by all plants employing over 250 people is recommended for calendar year 1962. In addition, a survey of water use by all plants in one small New Jersey county is suggested. Population studies of New Jersey predicted an abnormally high increase in population in the suburban municipalities. Studies of employment showed that manufacturing, which is the principal industry of New Jersey, employs 50% of all those employed and uses about 90% of the water used by all industry.

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN: ECONOMIC AND SOCIAL IMPACTS OF GROUNDWATER CONTAMINA-TION; A CASE STUDY IN EAST BAY TOWN-SHIP, GRAND TRAVERSE COUNTY, MICHI-CAN

Northwest Michigan Regional Planning and De-

velopment Commission, Traverse City. For primary bibliographic entry see Field 5C. W86-00218

WATER AND THE CITY, Lund Univ. (Sweden). Dept. of Water Resources

Engineering, G. Lindh. United Nations Educational, Scientific and Cultural Organization, Paris, France. 1983. 54 p.

Descriptors: *Urbanization, *Water demand, *Economic development, *Social impact, *Agriculture, Irrigation, Wastewater treatment, Water treatment, Planning, Environmental effects, Water supply, Water use, Saline soils, Groundwater, Rivers, Wells, Vegetation, Runoff, Urban runoff, Urban drainage, Floods, Subsidence, Storm water, Recharge, Public health, Combined sewers, Water transfer, Desalination.

This booklet traces the relationships between water and urban society from primitive times to the present and highlights some of the problems in water supply and quality. One of the major turning points in human history was irrigation, which was the beginning of food surpluses and the progression from farm to village to town to city to metropolis. In many regions of the world a water-demanding society has exploited water resources so that development costs rise dramatically. Early cultures, with few exceptions, have developed along rivers in Egypt, Mesopotamia, India, and China. However, some scholars postulate that water scarcity led to technological advances and improved agricultural practices. History records soil salination, pollution of watercourses with sewage and industrial wastes and other problems. The impact of city growth on water quantity and quality has increased with the size of cities and the loss of open land to building and paving. Urban flooding is an especially serious problem, destroying property and carrying pollutants. Water supply and wastewater treatment in developing countries and industrial regions are described. Examples of solutions are water transfer, reservoirs, seawater distillation, and individualized waste treatment and water pollution prevention schemes. As water demand increases, land subsidence and salt water intrusion increase. The importance of water planning and management is emphasized.

MODELING WATER DEMANDS. Academic Press, New York, NY. 1984. J. Kindler and C.S. Russell, editors. 248 p, 205 Ref.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Municipal water, Economic aspects, Water management, Water requirements, Forecasting, Water supply, Water policy, Regional planning, Industrial water, Agriculture, Linear programming, Statistical models, Mathematical

This book presents the basic concepts and techniques of water demand modeling. Several case studies undertaken by the International Institute for Applied Systems Analysis are given. Most planning is based on demand (price dependent water use) rather than on requirement (irreducible water use). Statistical or engineering approaches to modeling are described, and examples of both are given. Modeling techniques are applied to three aspects of water use: industrial, agricultural, and municipal. Modeling is extended to the regional and national levels. Difficulties with the national level models are highlighted. However, they can provide enough information to avoid truly enormous mistakes in water management, for example, an unnecessary interregional water transfer.

WATER DEMAND, B. T. Bower, J. Kindler, C. S. Russell, and W. R. D. Sewell. In: Modeling Water Demands, Academic Pres New York, NY. 1984. p 1-22, 6 Fig, 1 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Prices, *Model studies, Economic aspects,

Water management, Water requirements, Elasticity of demand, Water quality, Water rates, Water policy, Water supply, Consumptive use.

The introductory chapter to the book, 'Modeling Water Demands,' defines the water demand prob-The introductory chapter to the book, 'Modeling Water Demands,' defines the water demand problem and introduces relevant terms. Some functions of water resources management are planning, design, construction, and operation. Analyses of water use problems are divided under three headings: (1) baseline forecasting, (2) predicting impacts of direct policy intervention and indirect impacts of related policies, and (3) balancing use and supply. Several terms used in the analysis of water demand are defined. Demand and requirement are often used interchangeably. However, demand denotes the willingness of consumers to purchase a product, depending on the price; requirement means the quantity purchased regardless of price. Elasticity of demand is the percentage by which the quantity demanded changes for a 1% change in the price. The price of water may be determined by the interaction of supply and demand or through administrative decisions. Six dimensions of water demand are mentioned; these include with-drawals, gross water used, consumptive use, discharge, wastewater services demanded, and time patterns for the preceding dimensions. Water demand also has temporal variation—day to day, seasonally, and year to year. seasonally, and year to year. W86-00271

METHODOLOGICAL FRAMEWORK, International Inst. for Applied Systems Analysis, Laxenburg (Austria).

J. Kindler, and C. S. Russell.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 23-50, 4 Fig.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, Economic aspects, Water management, Water requirements, Linear programming, Water supply, Statistical models, Math-

Two types of water demand modeling are described-statistical and engineering. The statistical approach views an activity (example, steel mill) as a black box with inputs and outputs, not considering the processes occurring within the activity. The engineering approach details the activity with individual unit processes. Modeling by the statistic The engineering approach details the activity with individual unit processes. Modeling by the statistical approach involves several steps: choosing the model structure, i.e., selecting variables and hypothesizing structural relationships; choosing functional forms; estimating model parameters; verifying and validating the model; and using the model. Mathematical programming can be applied to the engineering approach. Linear programming is shown as an example. Whichever approach is used, the model is verified and validated. Verification is the determination of whether or not the correct the model is verified and validated. Verification is the determination of whether or not the correct model has been developed from a given single set of data describing water demand relations. Validation is testing of the model against one or more independent sets of data. Choice of model type depends on data availability, skills and interests of the modeling team, available computational facilities, and the intended application. W86-00272

INDUSTRIAL WATER DEMANDS, Operational Economics, Inc., Houston, TX.
J. C. Stone, and D. Whittington.
In: Modeling Water Demands, Academic Press,
New York, NY. 1984. p 51-100, 9 Fig, 3 Tab.

Descriptors: "Planning, "Water demand, "Water use, "Model studies, "Industrial water, "Pulp and paper industry, "Electric power industry, Economic aspects, Water management, Water requirements, Linear programming, Water supply, Statistical models, Mathematical models, The Netherlands, Poland, Prices, Cooling water.

Two approaches to modeling industrial water demand relationships are discussed and illustrated. The statistical approach is used to model demands for the Dutch paper industry. It focused on esti-mating water demand relationships and gives a list

Field 6—WATER RESOURCES PLANNING

Group 6D-Water Demand

of some econometric problems most likely to be encountered. Statistical estimation in the industrial water sphere is in its infancy. Problems include small sample sized available, lack of necessary data, and the simultaneous determination of price and quantity of water. The mathematical programming approach is illustrated with a determination of the water demand for electricity generation in of the water demand for electricity generation in Poland. The discussion includes a general descrip-tion of the structure and components of the mathe-matical model, the process of model construction and specification, and model use and results. W86-00273

AGRICULTURAL WATER DEMANDS, I. V. Gouevsky, and D. R. Maidment. In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 101-147, 16 Fig, 5 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Agriculture, *Irrigation, Livestock, Cattle, Economic aspects, Water management, Water requirements, Linear programming, Water supply, Mathematical models, Crop production, Bulgaria, Wheat, SWIM 2 model.

Agricultural water demands in crop production and livestock production are individually discussed. Water demands of individual and regional agricultual activities are considered, using as an example a linear programming model with a one type crop (wheat), one type animal (cattle) system. Among the information that can be derived from this simple example are the demand function for total irrigation water withdrawals and the demand function for wastewater discharges. The water demands of a large agroindustrial complex in the Silistra region of Bulgaria is analyzed and forecasted using the SWIM 2 model.

MUNICIPAL WATER DEMANDS, Johns Hopkins Univ., Baltimore, MD. Dept. of Applied Economics. S. H. Hanke, and L. de Mare. In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 149-169, 3 Fig, 8 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Municipal water, Industrial water, Water loss, Malmo, Sweden, Statistical models, Economic aspects, Water management, Water requirements, Elasticity of demand, Water rates, Water supply, Prices.

Municipal water uses may be grouped into six categories, based on the volumes of water and wastewater involved and the timing of their use. The categories are residential, industrial, commercial transportation, public, and lost and unaccount-ed for water. Residential water use may be over cial transportation, public, and lost and unaccounted for water. Residential water use may be over half of total municipal use in many communities. Statistics on mean residential water use for different activities, in different types of residences, and diurnal patterns are presented. Commercial water use is variable-20-55 liters per employee-day in offices, 100 liters per employee-day in businesses with dirty conditions, and up to 1900 liters per day per washing machine in a laundry. Water use in public service activities are 630 liters per day per patient in a hospital, about 300 liters per day per patient in a hospital, about 300 liters per day per patient in a hospital, about 300 liters per day per patient in a hospital, about 300 liters per day per sudent in schools with showers and cafeteria, and up to 200 liters per day per user in swimming pools. Leakage and undermetering are responsible for much lost and unaccounted for water, up to 50% in some systems. Statistical methods have proved more suitable for modeling municipal water demands than the engineering approach. An example of statistical modeling is given for residential water demand in the city of Malmo, Sweden.

W86-00275

PROGRAMMING MODELS FOR REGIONAL WATER DEMAND ANALYSIS, Resources for the Future, Inc., Washington, DC.

C. S. Russell. In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 171-206, 11 Fig, 3 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Regional planning, Delaware Valley, Statistical models, Economic aspects, Water management, Water requirements, Industrial water, Water quality, Wastewater treatment, Water supply, Estuaries, Mathematical models, Linear programming.

The design and construction of regional water demand models uses mathematical programming models of individual water use activities, such as industrial, agricultural, and municipal. Since regional models can easily become enormous and complicated, techniques for size reduction and simplification are given. A regional modeling project involving the lower Delaware Valley is used as an example. Although it deals only with water quality involving the lower Delaware valley is used as an example. Although it deals only with water quality and not quantity, many of the principles of model design and size reduction are illustrated. Since each region is unique, models must be custombuilt. A handbook which combines standardized parts to produce a regional model is not yet avail-W86-00276

NATIONAL PERSPECTIVE IN WATER DEMAND MODELING, International Inst. for Applied Systems Analysis,

International inst. for Applied Systems (Austria).

J. Kindler, and C. S. Russell.

In: Modeling Water Demands, Academic Press,
New York, NY. 1984. p 207-219, 3 Fig, 2 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Municipal water, Economic aspects, Water management, Water requirements, Forecasting, Water supply, Water policy, Regional

Attempts to apply the concept of water demand to the national level are difficult and of limited relevance. Most work has been directed toward use rather than demand. Baseline forecasting, usually undertaken to identify problems before the crisis stage, is not too effective on a national basis. To get the best results, forecasting should be done on a regional basis with some consideration of upper stream department. a regional basis with some consideration of up-stream/downstream relations. Several national water studies are described. Poland has a long history of national water studies dating to 1953-56. A macro interregional linear programming model U.S. agriculture provides much information on least-cost distribution of agricultural production. A water use forecasting study done in Japan in the 1970s has five major components: a macroeconom-ic model-input-output model and four submodels (municipal, household, industrial, and agricultural). When national aggregated projections of water use are made, several problems develop. Possible in traregional problems are understated or eliminated. traregional problems are understated or eliminated. The models also overstate net withdrawal totals by are anothers also overstate net withdrawal totals by ignoring reuse. If the water use exceeds the supply on a national basis, large and wasteful water supply projects or irrigation projects are often conceived without regard to regional conditions. W86-00277

6E. Water Law and Institutions

NATIONAL WATER SUMMARY 1983-HY-DROLOGIC EVENTS AND ISSUES. Geological Survey, Reston, VA. Water Resources For primary bibliographic entry see Field 6B. W86-00131

ACID RAIN: DOES SCIENCE DICTATE POLICY OR POLICY DICTATE SCIENCE, Georgia Univ., Athens. Inst. of Natural Resources. J. L. Regens.
IN: Acid Precipitation Series, Volume 8: Economic Processing Control Processing Control Pr

ic Perspectives on Acid Deposition Control, But-terworth Publishers, 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 5-19, 2 Tab, 48 Ref.

Descriptors: *Policy making, *Acid rain, *Water quality control, *Air pollution, Precipitation, Fallout, Monitoring, Sulfur oxides, Fate of pollutants,

Model studies, Research priorities, Water pollution effects, Environmental effects, Economic aspects, Decision making, Public policy, Water pollution

Research can contribute significantly to reducing the current level of uncertainty about the causes and consequences of the acid deposition problem. However, science can never provide the last word with absolute certainty. Clearly, such a mission represents an impossible task, although research can be used to improve significantly the quality of information in areas important for decision-makers. Enhanced understanding of the causal factors and potential consequences of acid deposition enables policymakers to identify and select those courses of action which, given their own value systems, address most appropriately the problem. Thus, science neither dictates the policy nor policy the science. Instead, a symbiotic relationship exists between the two. Knowledge from one domain can foster choice in the other. (Author) Research can contribute significantly to reducing W86-00137

LEGAL, ETHICAL, ECONOMIC AND POLITICAL ASPECTS OF TRANSFRONTIER POLLU-TION.

TION,
Resources for the Future, Inc., Washington, DC.
A. V. Kneese, and R. C. D'Arge.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 123-133, 1 Tab, 13 Ref.

Descriptors: *Political constraints, *International agreements, *Water pollution effects, Economic aspects, Legal aspects, Ethics, Efficiency, Jurisdiction, Liability, Negotiations.

Compensated and uncompensated transnational pollution problems have been analyzed. Compensation among nations is necessary to achieve economic efficiency, in that costs and benefits will be adequately compared. For many Western ethical criteria, uncompensated risks imposed by one nation on others could be unethical, but this decriteria, uncompensated risks imposed by one nation on others could be unethical, but this depends on the ethical criterion as well as differences in income and other political considerations. Because of differences in the mix of ethical beliefs among nations along with the desire to maintain national sovereignty, no all-inclusive principle is likely to emerge to solve transnational pollution problems. What is likely to emerge is a sequence of relatively unique solutions that blend economic necessity with political cunning and goodwill. However, the first step appears to be that every nation agrees to negotiate in good faith toward a solution of transnational pollution provided there is sufficient evidence of economic benefit and cost. The record on international settlement of transnational pollution does not lead to a clear and concise set of guiding international principles. The various cases demonstrate the various possibilities ranging from full costing to victim pays. It is unlikely that such piecemeal solutions will lead to economic efficiency in a global sense. Yet, as long as there are gains from trade are negotiated over and obtained, everyone should be as well off or better than without negotiation. (Author) W86-00143 W86-00143

SURVEY OF NATIONAL AND STATE REGULATORY AGENCY POLICY AND PROCEDURES FOR THE DETERMINATION OF THE TOXICITY OF WASTEWATER EFFLUENTS.

Ecological Analysts, Inc., Sparks, MD. API Publication 4353, American Petroleum Insti-tute, Washington, DC., November 1982. 133 p, 1 Fig, 7 Tab, 6 Ref, 2 Append.

Descriptors: *Toxic wastes, *Public policy, *Water pollution effects, *Standards, *Wastewater management, *Toxicity, *Industrial wastes, Bioasay, Aquatic animals, Permits, State jurisdiction, Regulations, Oil refineries, Water policy, Surveys.

The U.S. EPA and state regulatory agencies use effluent toxicity testing on a case-by-case basis to

Ecologic Impact Of Water Development—Group 6G

evaluate the acute toxicity of effluents. It appears likely that effluent toxicity testing, especially given the activities in U.S. EPA Region VI, and other the activities in U.S. EPA Region VI, and other water quality-based regulatory procedures will be used in upcoming years to help evaluate point source industrial discharges. The extent and degree to which this occurs will depend on the direction and guidance developed by U.S EPA in Washington, D.C., the specific U.S. EPA regional offices, and the individual states. Since use of effluent toxicity testing during the issuance of the second round of NPDES permits is dynamic, status of effluent toxicity testing in each state should be carefully investigated before making final environmental management decisions. (Author) W86-00211 W86-00211

WATER AND THE CITY,

Lund Univ. (Sweden). Dept. of Water Resources

Engineering.
For primary bibliographic entry see Field 6D.
W86-00264

OPPORTUNITIES TO PROTECT INSTREAM FLOWS IN ALASKA,

FILOWS IN ALASKA, M. R. White. Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124974. FWS/OBS-82/33, July 1982. Fish and Wildlife Service, Washington, DC. Office of Biological Services. 30 p, 2 Tab, 45 Ref. Contract/Grant No. 14-16-009-79-100.

Descriptors: *Water law, *Water policy, *Alaska, *Water management, *Rivers, Instream flow, Fish, Aquatic life, Rivers, Resources management, Water use, Appropriation, Legal aspects, Legislation, Water rights, Permits, Land acquisition, Wildlife, Water resources.

This report, intended for the use of planning and management personnel, identifies and describes promising opportunities for protecting instream uses of water under existing Alaskan law. It is designed as a guide through the Federal and state statutes and administrative practices. Sections include Department of Natural Resources conditions on appropriative rights, reservation of instream on appropriative rights, reservation of instream flows, Department of Fish and Game acquisition of land and water, anadromous fish permits, pollution laws, municipal condemnation, Renewable Resources Fund, coastal zone management, Marine Fisheries Compact, and Public Trust Doctrine. W86,00280

6F. Nonstructural Alternatives

FLOOD DAMAGE ALLEVIATION IN NEW

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. S. Dola.

Water Resources Circular 3, New Jersey State Dept. of Conservation and Economic Develop-ment, 1961. 20 p, 22 Ref.

Descriptors: *Flood plain zoning, *Flood plain management, *Flood control, *Flood damage, *New Jersey, Water resources development, Flood protection, Flood plains, Zoning.

New Jersey is faced with serious flood problems due to increasing population and development in flood prone areas such as the Passaic and Delaware river basins. Only through Federal participation in the construction of engineering structures such as dams and local protective works can future flood damage to existing developments be reduced. The U.S. Army Corp of Engineers is now compiling data on floods and flood damages to promote better zoning in the Passaic Valley. The U.S. Weather Bureau is conducting flood forecasting in the Delaware, Raritan, and Passaic river valleys. The Soil Conservation Service gives technical, cost-sharing, and carrying out works of improvement for flood prevention, and agricultural and nonagricultural water management. The U.S. Geological Survey gathers data on floods by gaging

streams throughout New Jersey. The municipal encroachment law permits municipalities to construct improvements, remove obstructions, define the location, establish widths, grades, and elevations of any stream and to prevent encroachments thereon of the flood carrying capacity to be provided. The 1929 Encroachment Law for flood damage alleviation in New Jersey is basically a preventive measure approach. The Tennessee Valley plan for flood plain regulation would divide the responsibility between state and local governments. W86-00173

6G. Ecologic Impact Of Water Development

REVIEW OF THE EFFECTS OF WATER-LEVEL CHANGES ON RESERVOIR FISHER-IES AND RECOMMENDATIONS FOR IM-PROVED MANAGEMENT, Fish and Wildlife Service, Fayetteville, AR. Na-tional Reservoir Research Program. G. R. Ploskey.

G. R. Ploskey.

Technical Report E-83-3, February 1983. Final
Report. U.S Army Environmental and Water
Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 83 p,
203 Ref. Intra-Army Order WESRF-82-24.

Descriptors: *Reservoir fisheries, *Fish, *Water level, Water properties, Water level fluctuations, Reservoir releases, Water temperature, Reservoir roperation, Ecosystems, Erosion, Turbidity, Chemical properties, Dissolved oxygen, Fish harvest, Nutrients, Flooding, Drawdown, Aquatic plants, Benthos, Spawning, Zooplankton, Literature

Information gathered from available literature sources about the physico-chemical and biological effects of water-level changes on reservoir ecosys-tems is summarized. The effects of variations in terrects of water-level changes on reservoir ecosystems is summarized. The effects of variations in both the physical environment (i.e., basin morphometry, bottom substrates and structures, erosion turbidity, temperature, and water-retention time) and the chemical environment (i.e., nutrients and dissolved oxygen) caused by water-level changes on a reservoir's production of fish are described. The complex ways in which water-level changes affect aquatic plants, zooplankton, and the benthos and how these trophic variations can eventually affect the growth, reproduction, and harvest of fish are discussed. The final part of the report summarizes the effects of drawdown and flooding on reservoir fish populations and recommends ways to manage reservoir fluctuation zones by making controllable variables (magnitude, frequency, and timing of water-level change) as favorable as possible for fish survival, spawning, and feeding. W86-00158

TECHNIQUES TO REDUCE THE SEDIMENT RESUSPENSION CAUSED BY DREDGING, Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. For primary bibliographic entry see Field 5G. W86-00139

LONG-TERM IMPACT OF DREDGED MATERIAL AT TWO OPEN-WATER SITES: LAKE ERIE AND ELLIOT BAY; EVALUATIVE SUM-

MARY,
Army Engineer Waterways Experiment Station,
Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5C.
W86-00160

FISHES OF SELECTED AQUATIC HABITATS ON THE LOWER MISSISSIPPI RIVER, Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. C. H. Pennington, J. A. Baker, and C. L. Bond. Technical Report E-83-2, January 1983. Final Report. 96 p, 22 Fig, 19 Tab, 39 Ref, Append.

Descriptors: *Environmental effects, *Aquatic habitats, *Fish, *Channel improvement, Mississippi

River, Dikes, Stream banks, Banks, Erosion control, Revetments, Bank erosion, Flood control, Habitats, Aquatic animals.

Fish species diversity, abundance, and distribution were studied in four habitats (dike fields, revetted were studied in four habitats (dike fields, revetted banks, natural banks, and an abandoned river chan-nel) in the Lower Mississippi River near Green-ville, Mississippi. The largest number of fish spe-cies was found in the dike field habitat (53), fol-lowed by the abandoned channel (31), revetted banks (27), and natural banks (24). Dike fields were banks (27), and natural banks (24). Dike fields were similar at most sampling periods with respect to species composition but were often different in the relative abundances of the constituent species. The natural banks were generally similar in species composition and relative abundance, while the re-vetted banks showed greater variability and over-all lower similarity. The numerical catch per unit effort was seldom significantly different among habitats Catches on resetted banks were generally habitats. Catches on revetted banks were generally higher than on natural banks. In November 1979 the catch per unit effort was 7 times that of any other habitat. Biomass catch per unit effort was greatest in the revetted bank habitat, followed in order by dike fields, natural banks, and abandoned channel, with two exceptions. In April 1979 the biomass catch per unit effort in the abandoned channel was greater in dike fields and natural banks than in revetted banks; in November 1979 the biomass catch per unit effort was greatest in the abandoned channel. Condition factors were not significantly different among the habitats or sea-sons. Age 0 fish were abundant in dike fields and to a lesser extent, in the abandoned channel. Mostly adult fish were collected at natural banks and revetted banks.

ARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS: THE HERPETOFAUNA OF LAKE CONWAY, SPECIES ACCOUNTS,

University of South Florida, Tampa. Dept. of Biol-

G. T. Bancroft, J. S. Godley, D. T. Gross, N. N. Rojas, and D. A. Sutphen.
Miscellaneous Paper A-83-5, July 1983. Final Report. U.S. Army Aquatic Plant Control Research program, Army Engineer Waterways Experiment Station, 304 p, 62 Fig, 42 Tab, 104 Ref, 2 Append.

Descriptors: "Weed control, "Environmental effects, "Aquatic weed control, "Wildlife, "Lakes, Aquatic animals, "Reptiles, "Amphibians, Snakes, Frogs, Turtles, Fish, White amur, Lake Conway, Florida, Ecosystems, Aquatic habitats, Habitats, Salamanders, Alligators.

Species accounts of the herpetofauna of Lake Conway, Florida, were developed to assess any changes resulting from use of the white amur to control aquatic plants. During 1977-1980 ecological were recorded for 2 of 4 salamanders, all 8 frogs, the American alligator, 5 of 10 turtles, and 1 of 7 snakes. The change most often noticed was a change in relative density, followed by seasonal activity. Description of the production structures over water habitat change in relative density, followed by seasonal activity, population structure, open water habitat use, food habits, and movement patterns. No yearly variation was detected in the use of specific littoral zone habitats, growth rates, or reproductive output per individual. The white amur was implicated in ecological changes in 1 salamander and 3 turtle species. This was related to macrophyte removal by the fish, combined with other disturbance phenomena: shoreline development, destruction or removal of individuals from the lake system, boat propeller mortality, investigator efsystem, boat propeller mortality, investigator ef-forts, water level fluctuations, and weather condi-W86-00202

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 3: BENTHIC MACROINVER-TEBRATE STUDIES PILOT REPORT,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.

Field 6-WATER RESOURCES PLANNING

Group 6G-Ecologic Impact Of Water Development

D. B. Mathis, S. P. Cobb, L. G. Sander, A. D. Magoun, and C. R. Bingham. Miscellaneous Paper E-80-1, April 1981. Report 3 of a Series. 83 p, 12 Fig. 16 Tab, 8 Ref.

Descriptors: "Environmental effects, "Ivertebrates, "Waterways, "Aquatic habitats, Habitats, Mississippi River, Aquatic animals, Aquatic life, Macroinvertebrates, Benthos, Channels, Dikes, Sand, Banks, Stream Banks, Flow control, Caddisflies, Mayflies, Oligochaetes, Aquatic insects, Insects, Chicacomids

Benthic macroinvertebrates were sampled on the Lower Mississippi River, River Mile 480 to 530. A total of 20,562 organisms, representing 72 distinct taxa, 17 orders, and 5 classes were collected. The three most productive habitats were dike structures (563.4 organisms per rock sample), abandoned channels (70.04 organisms per 0.05 sq m), and natural banks (9.4 organisms per 0.05 sq m). The dike structures contained primarily caddisflies, chironomid larvae, and mayflies. Abandoned channels contained oligochaetes, dipteran larvae, and fingernail clams. Natural banks featured burrowing mavflies and clinging macroinvertebrates. These mayflies and clinging macroinvertebrates. These three habitats were relatively stable compared with the other less productive habitats, dike fields, rewetted banks, permanent secondary channel, tem-porary secondary channel, main channel, and sand bars. W86-00212

EFFECTS OF BEACH NOURISHMENT ON THE NEARSHORE ENVIRONMENT IN LAKE HURON AT LEXINGTON HARBOR (MICHI-

GAN), Coastal Engineering Research Center, Fort Bel-

Coastal Engineering Research Center, Fort Belvoir, VA.
R. T. Nester, and T. P. Poe.
Miscellaneous Report No. 82-13, November 1982.
56 p. 5 Fig. 10 Tab, 17 Ref, 5 Append. Project No.
G31533.

Descriptors: *Environmental effects, *Erosion control, *Beaches, *Shore protection, *Lakes, Lake Huron, Lexington Harbor, Michigan, Benthos, Invertebrates, Fish, Water quality, Protection, Dredging, Bottom sediments, Suspended sediment, Turbidity.

A beach nourishment project at Lexington Harbor, Michigan, had no significant adverse effect on the nearshore aquatic environment, as determined by aerial photography, water analysis, and sampling of lake bottom sediments, macrozoobenthos, and fish. However, the beach face profile changed markedly during the 14-month study. By the end of the study, a moderate lakeward extension of the beach face was present in the area immediately south of the harbor.

W86-00224

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 6: LARVAL FISH STUDIES PILOT REPORT, Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. H. L. Schramm, and C. H. Pennington. Miscellaneous Paper E-80-1, April 1981. Report 6 of a Series. 74 p, 4 Fig, 29 Tab, 10 Ref.

Descriptors: ^aEnvironmental effects, ^aAquatic habitats, ^aFish, ^aWaterways, Habitats, Mississippi River, Aquatic animals, Aquatic life, Larvae, Channels, Dikes, Sand, Banks, Stream banks, Flow control, Oxbow lakes, Sampling, Diurnal distribution Herical Company. tion, Herring, Carp.

arval fish were collected in 9 habitats in the Larval fish were collected in 9 habitats in the Lower Mississippi River during the spawning season. Abandoned channels and oxbow lakes had relatively low diversity and high densities of clu-peids and centrarchids. Natural banks and revetted banks had high density and abundance of larval fish. Dike fields had high diversity and moderate density of larval fish. Three of the four main channel sampling stations showed low diversity and density of larval fish. The fourth main channel had high diversity and high density on two sam-

pling dates. In temporary secondary channels the density of larval fish was low and the diversity was high. Both density and diversity were low in the permanent secondary channel and in the sand bar. permanent secondary channel and in the sand bar. The number of taxa and the density of larvae were greatest at dusk. Twelve taxa were collected only greatest at dusk. I'welve taxa were collected only at dusk, dawn, or at night. Samples taken within a 1- to 2-hour period of a diel cycle did not constitute significant amounts of the variation in number of taxa or density of larval fish. In addition, samples collected with paired nets did not constitute a significant portion of the variation in number of taxa but did constitute a significant portion of the variation in density. variation in density. W86-00226

FLOOD CONTROL MINNESOTA RIVER, MINNESOTA, MANKATO-NORTH MANKATO-LEHILLIER: DESIGN MEMORANDUM NO. 8, PART I (LOCATION STUDY). Army Engineer District, St. Paul, MN. For primary bibliographic entry see Field 8A. W86-00238

GUIDE TO STREAM HABITAT ANALYSIS USING THE INSTREAM FLOW INCREMENTAL METHODOLOGY, Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.

K. D. Bovee

K. D. Bovee. Available from the National Technical Information Service, Springfield, VA 22161 as PB83-131052. Report No. FWS/OBS-82/26, June 1982. 249 p, 52 Fig, 31 Tab, 78 Ref, 2 Append.

Descriptors: *Environmental effects, *Streams, *Habitats, *Water analysis, *Aquatic life, Planning, Rivers, Instream Flow Incremental Methodology, Instream flow, Water yield, Sediment yield, Channel flow, Channeling, Water quality, Watersheds, Land use, Aquatic habitats, Aquatic animals, Reservoirs, Fish passages, Channel improvement, Hydrology, Water resources development.

drology, Water resources development.

The Instream Flow Incremental Methodology has been expanded and refined to produce an approach to the assessment of riverine habitats and the impact of disturbances on these habitats. The first chapters of this user's guide explain the overall approach of the methodology, describe activities that preceed data collection, show the sequence of data collection, and detail options for preparing, displaying, and interpreting the output. The later chapters contain necessary concepts of hydrology and channel dynamics and the Physical Habitat Simulation System. Stream habitat can be defined in terms of macrohabitat (temperature, water quality, sediment size and load, channel shape, slope, and flow regime) or microhabitat (distribution of depth, velocity, substrate, and cover within a specific area of the stream). Macrohabitat characteristics affect the longitudinal distribution of species and create longitudinal gradations in the microhabitat characteristics along the stream. The total habitat availability at any flow is defined by the area of overlap between suitable macrohabitat conditions and available microhabitat area. Total habitat may be determined with or without a project such as reservoir construction or channel improvement.

W86-00251 W86-00251

NORFOLK HARBOR AND CHANNELS DEEP-NORFOLK HARBOR AND CHANNELS DEEP-ENING STUDY, REPORT 1: PHYSICAL MODEL RESULTS, CHESAPEAKE BAY HY-DRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 2L. W86-00266

7. RESOURCES DATA

7A. Network Design

SYNTHESIS OF RADAR RAINFALL DATA, National Weather Service, Silver Spring, MD. Hy-drologic Research Lab.

For primary bibliographic entry see Field 2A. W86-00084

7B. Data Acquisition

STREX TOVS/RADIOSONDE COMPARISON, PART I: TOVS/AVHRR AND RADIOSONDE INVENTORY,

National Oceanic and Atmospheric Administra-tion, Seattle, WA. Pacific Marine Environmental

H. M. Byrne NOAA Data Report ERL PMEL-8, October 1982. 135 p, 3 Append

Descriptors: *Remote sensing, *Satellite technology, *Radiosondes, *Meteorological data collections, STREX, NAVAID, TOVS, AVHRR,

This report consists of four appendixes of data generated in 110 overpasses of the NOAA-6 polar orbiter. Appendix A is a catalog of 123 computer-generated coverage maps of the overpasses. They show the coverage of the AVHRR scanner during the pass and the coverage of the TOVS instruments. Appendix B tabulates the STREX NAVAID radiosonde and aircraft dropsonde data taken during the experiment. Appendix C consists of lists of translated passes including orbit number, data, and time, and the archive tape label at the University of Miami. Appendix D is the tabulation of the NAVAID radiosonde computer printouts on microfiche.

ARCTIC MARINE OILSPILL F (AMOP) REMOTE SENSING STUDY. PROGRAM

Canada Centre for Remote Sensing, Ottawa (On-

R. A. O'Neil.

Report EPS 4-EC-83-3, March 1983. Environmental Protection Service, Ottawa, Ontario. 257 p, 103 Fig, 6 Tab, 79 Ref, 10 Append.

Descriptors: *Remote sensing, *Satellite technology, *Path of pollutants, *Oil spills, Arctic, Cold regions, Ice, Oil slicks, Canada, Arctic Marine Oilspill Program, Radar, Television, Photography, Infrared imagery, Kurdistan, Nova Scotia, Montreal Harbor, Scott Inlet, Data aquisition.

The Arctic Marine Oilspill Program studied remote sensing of oil slicks on ice-infested waters. Experiments were conducted in Montreal Harbor, Scott Inlet, off the New Jersey coast, and off the Nova Scotia coast (Kurdistan spill). A recommended integrated sensor package included a side-looking radar, an ultraviolet-infrared dual channel line scanner, a laser fluorogensor, a low-light-level line scanner, a laser fluorosensor, a low-light-level television, and annotated photographic cameras. A real-time display system was recommended to allow operator interaction with the sensors.

W86-00258

BOULDER UPSLOPE CLOUD OBSERVATION EXPERIMENT.

National Oceanic and Atmospheric Administra-tion, Boulder, CO. Environmental Research Labs. For primary bibliographic entry see Field 2B. W86-00261

USE OF SATELLITE IMAGERY FOR TRACK-ING THE KURDISTAN OIL SPILL, Remotec Applications Ltd., St. John's (Newfound-

land).

B. R. Dawe, S. K. Parashar, J. P. Ryan, and R. D.

WORSIGH.

Report EPS 4-EC-81-6, December 1981. Environmental Protection Service, Ottawa, Ontario. 31 p, 19 Fig, 3 Tab, 10 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Oil spills, Oil slicks, Kurdistan, Path of pollutants, LANDSAT, TIROS, Ice, Cape Breton Island, Infrared imagery.

Evaluation, Processing and Publication—Group 7C

The effectiveness of using satellite imagery in locating, monitoring, and tracking oil spills in open water was studied after the tanker Kurdistan broke in two pieces in ice off Cape Breton Island on March 15, 1979. The accident released 7000 metric tons of Bunker C oil. Results of the study were inconclusive. A major oil slick was located on only one occasion. At this time only TIROS AVHRR imagery with a reduced dynamic range (2 significant bits missing) was available. All other TIROS and LANDSAT data had no confirmed slicks within the imaged areas. Sun elevations and wind speeds were unfavorable for detection of oil slicks by satellite imagery. However, LANDSAT data detected a confirmed oil-on-ice slick in Gabarouse Bay. Band 4 provided the best contrast, whereas Band 7 was the worst. TIROS imagery over an oil-ice area did not detect an oil slick.

7C. Evaluation, Processing and Publication

MONITORING OF RESERVOIR VOLUME USING LANDSAT DATA,
Roorkee Univ. (India). Dept. of Earth Sciences.
R. P. Gupta, and S. Banerji.
Journal of Hydrology, Vol. 77, p 159-170, 1985. 7
Fig, 1 Tab, 18 Ref.

Descriptors: *Reservoir storage, *Remote sensing, *Landsat, *Satellite technology, *Ramganga dam reservoir, *India, Mountain lakes, Water depth, Topography, Lake morphology, Lake morphome-

Measuring depth of a water body by remote sensing is limited by several factors such as turbidity, depth of water, type of bedrock material, wavelength used, etc. Measurement of width, length and area of a reservoir can be done rather easily with the help of satellite data. The accuracy of areal estimation is limited by the areal resolution of the sensor and topographic milieu. Computing lake surface area for estimating water volumes would have limited applicability in areas of high topographic relief. A method which was suggested by others and involves marking of land-water contact from satellite data along low-gradient channels was applied to the Ramganga dam reservoir (Himalayas, India) using Landsat MSS CCT's, field spectro-radiometric mensurements and theodolite surveys. The technique can be utilized in areas of known topography for real-time remote monitoring of fluctuations in reservoir volume. The elevation data obtained are very close to the recorded water level; taking design data as the standard data gives + or - 0.24% accuracy. For the sake of comparison, an attempt was also made to compute water volume by measuring lake surface area from the satellite data. The area of the reservoir can be measured upto an accuracy of + or -5.14%. Some element of inaccuracy in measuring reservoir surface area from finaccuracy in measuring

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1981 VOLUME 1: NORTHEAST FLORIDA.

FLORIDA.
Geological Survey, Orlando, FL. Water Resources
Div.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB83-170753.
USGS Water Data Report FL-81-1, 1982. 591 p, 34

Descriptors: *Florida, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections.

Water resources data for the 1981 water year in Florida consists of continuous or daily discharge for 279 streams, periodic discharge for 52 streams, continuous or daily stage for 64 streams, periodic stage for 82 streams, peak discharge for 78 streams and peak stage for 55 streams; continuous or daily

elevations for 77 lakes, periodic elevations for 144 lakes; continuous ground water levels for 483 wells, periodic ground water levels for 661 wells, and miscellaneous water level measurements for 2,807 wells; quality of water data for 301 surface water sites and 842 wells. The data for northeast Florida includes continuous or daily discharge for 57 stream, periodic discharge for 62 streams, peak discharge for 29 steams, low-flow discharge for 2 streams, continuous or daily stage for 28 streams; continuous or daily stage for 28 streams; continuous or 30 lakes; continuous ground water levels for 31 wells, periodic ground water levels for 31 wells, periodic ground water level measurements for 636 wells; quality of water for 80 surface water sites and for 702 wells. (USGS)

WATER RESOURCES DATA FOR COLORA-DO, WATER YEAR 1982, VOLUME 2. COLO-RADO RIVER BASIN ABOVE DOLORES

RIVER,
Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Ugland, J. T. Steinheimer, J. L. Blattner, and
R. G. Kretschman.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB83-120138.
USGS Water Data Report CO-82-2, 1983. 339 p, 6
Fig. 5 Tab. Prepared in cooperation with the State
of Colorado and other agencies.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Colorado River basin.

Water-resources data for Colorado for the 1982 water year consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes, and reservoirs, and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 408 gaging stations, stage and contents of 27 lakes and reservoirs, 6 partial-record low-flow stations, peak-flow information for 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 245 miscellaneous sites; and water levels for 55 observation wells. Nine pertinent stations in bordering States are also included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. (USGS) (USGS) W86-00128

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.

Geological Survey, Bismarck, ND. Water Re-Geological Survey, Bisinarca, Alexandre Sources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83 213785.
USGS Water Data Report ND-81-1, 1982. 325 p, 7

Descriptors: *North Dakota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperatures, sampling sites, Water levels, Water analyses, *Data collections, Hudson Bay basin.

Water resources data for the 1981 water year for North Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. Volume 1 of this report contains 67 gaging stations; stage only records for 6 gaging stations; stage and contents for 4 lakes and reservoirs; water quality for 24 gaging stations; 10 partial-record stations, 14 lakes, 26 wells, and water levels for 19 observation wells. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. (USGS).

W86-00129

WATER RESOURCES DATA HAWAII, OTHER PACIFIC AREAS, WATER YEAR 1981. VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRO-NESIA, PALAU ISLANDS AND AMERICAN SAMOA.

Geological Survey, Honolulu, HI. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83 171116. USGS Water-Data Report HI-81-2, 1982. 148 p, 16

Descriptors: *Pacific area, *Hydrologic data, *Surface water, *Groundwater, *Water quality, *Flow rate, Gaging stations, Chemical analyses, Sediments, Reservoirs, Water temperatures, Sampling sites, Water levels, *Data collections.

Volume 2 of water resources data for the 1981 water year for other Pacific areas consist of records of stage, discharge, and water quality of streams; stage of a reservoir; and water levels in wells and springs. This report contains discharge record for 41 gaging stations; stage only record for 2 gaging stations; water quality for 3 gaging stations, 39 partial-record stations; water temperature for 60 gaging stations; and water levels for 10 observation wells. Also included are 47 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic collected at various sites, not part of the systematic data collection program, and are published as mis-cellaneous measurements. (USGS). W86-00130

SEDMNT: A SEDIMENT TRANSPORT SUB-MODEL BASED ON HYDRODYNAMIC PRIN-CIPLES FOR THE UNIFIED TRANSPORT

Oak Ridge National Lab., TN. Environmental Sciences Div.

For primary bibliographic entry see Field 2J. W86-00155

FOUNDATIONS OF PRINCIPAL COMPONENT SELECTION RULES,

Scripps Institution of Oceanography, La Jolla, CA. R. W. Preisendorfer, F. W. Zwiers, and T. P. Barnett.

SIO Reference Series 81-4, May 1981. 192 p, 37 Fig, 33 Tab, 75 Ref.

Descriptors: *Data processing, *Data interpreta-tion, *Model studies, *Temperature, Air tempera-ture, Meteorology, Principal component analysis, Methematical studies

Mathematical studies.

The problem of separating signal from noise in a given space-time data set of geophysical fields which has been rendered into its principal component representation is considered. These separations are effected by two main sets of selection rules: dominant-variance and time-history. The dominant-variance rules are based on the fact that the covariance matrix of the sum of a signal and a noise data set generally have a recognizably different eigenvalue curve than that of each of the two summands so that, under hypothesized noise and sampling conditions, the presence of a signal can be inferred with a chosen level of confidence. The time-history rules are based on the temporal evolution of the given data set's principal component series, and test the hypothesis that the series are of a given noise type. A rejection of the hypothesis about a particular component series at a given level of confidence results in the selection of the principal component as potentially signal-like. Nine dominant-variance rules and eight time-history rules were tested. Methods of interpreting principal component representations of data sets are given. Suggestions are also given for associating possible underlying dynamical models to these representations.

W86-00186 W86-00186

Field 8—ENGINEERING WORKS

Group 8A—Structures

8. ENGINEERING WORKS

8A. Structures

OPTIMAL URBAN WATER DISTRIBUTION DESIGN,
MacLaren Engineers, Winnipeg (Manitoba).
For primary bibliographic entry see Field 5F.
W86-00071

WEIR JETTY PERFORMANCE: HYDRAULIC AND SEDIMENTARY CONSIDERATIONS, HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. W. C. Seabergh.

W. C. Seabergh.
Technical Report HL-83-5, March 1983. Final Report. 298 p, 43 Fig. 3 Tab, 59 Photos, 105 Plates, 32 Ref. 2 Append.

Descriptors: *Performance evaluation, *Jetties, *Hydraulic models, Tidal rivers, Sediment transport, Tidal hydraulics, Flood flow, Ebb flow, Sedi-

This study was performed to quantify the design parameters of an efficient sediment-handling weir jetty system. A 150-ft by 350-ft facility, yielding a 1:100 scale, in which the bay area was either partially filled (low Keulegan K value) of nearly filled (high Keulegan K value), was used to provide extremes of velocity-tidal elevation flow relationships over the weir Sediment tracers and a vide extremes or velocity-tions elevation now ream-tionships over the weir. Sediment tracers and a movable-bed beach section provided the means to examine the deposition. Results indicate the mean tidal level weir elevation is the most practical elevation for providing wave protection for a dredge, good sediment transport across the weir, and good flood-ebb tidal flow relationships. Strong ebb flow currents over the weir are not desirable ebb flow currents over the weir are not desirable as they might aid in migration of the navigation channel through the deposition basin. Jetty systems with the outer, more oceanward portions parallel to each other and at minimum spacing provide the best flow characteristics when tidal current migration through the deposition basin region is considered. Wave-generated currents upcoast of the weir jetty are not entirely captured by the weir but some current, and thus sediment, moves oceanward along the outer portion of the jetty. Also, reflected waves off the jetty and weir structure combine with incident waves to form a short-crested wave field which aids in removal of sedicrested wave field which aids in removal of sedi-ment from the upcoast beach, to various degrees, ment from the upcoast beach, to various degrees, depending on the structure's angle with respect to the shoreline and the incident wave angle. The effects of groins adjacent to the weir section were examined with regard to providing additional fillet storage and reducing the sediment movement in an oceanward direction along the jetty. Positive results were found for each variation tested. W86-00152

BARCELONA HARBOR, NEW YORK, DESIGN FOR HARBOR IMPROVEMENTS: HYDRAU-LIC MODEL INVESTIGATION,

astal Engineering Research Center, Vicksburg,

MS

R. R. Bottin. Technical Report CERC-84-3, August 1984. Final Report. 290 p, 6 Fig, 25 Tab, 134 Photos, 28 Plates, 15 Ref, 3 Append.

Descriptors: *Hydraulic models, *Harbors, *Docks, Wave action, Wave height, Barcelona

A 1:60-scale (undistorted) hydraulic model of Bar-A 1:60-scale (undistorted) hydraulic model of Bar-celona Harbor, New York, including approximate-ly 7,000 ft of the New York shoreline and sufficient offshore bathymetry in Lake Erie to permit gen-eration of the required test waves, was used to investigate the design of certain proposed improve-ments with respect to wave action. Proposed im-provements consisted of: (1) rubble-mound break-water extensions, (2) rubble-mound absorbers in-stalled along the harbor sides of the existing east and west break-waters and the lackward face of and west break-waters and the lakeward face of the city dock, (3) rubble-mound spurs installed

southerly of the lakeward heads of the existing breakwaters, and (4) a parapet wall installed on the existing west breakwater. Two 60-ft-long wave generators and an Automated Data Acquisition and Control System were utilized in model oper-ation. An optimum improvement plan was selected based on the results of wave-height tests using monochromatic waves and spectral wave tests.

NAVIGATION CONDITIONS IN VICINITY OF WALTER BOULDIN LOCK AND DAM COOSA RIVER PROJECT: HYDRAULIC MODEL IN-VESTIGATION,

Geological Survey, Reston, VA C. Myrick, and J. J. Franco.

Technical Report HL-84-11, December 1984. Final Report. 129 p, 16 Fig, 5 Tab, 77 Plates.

Descriptors: *Locks, *Navigation, *Hydraulic models, *Model studies, Models, Navigation canals, Navigation obstructions, Simulation analy-sis, Design criteria, Surges.

The Walter Bouldin Lock will be the first navigation lock proposed for development of navigation on the Coosa River Waterway. The lock will be located in the left overbank area of Walter Bouldin Dam. Three fixed hydraulic models were used to examine navigation conditions in the reach in areas where difficulties were expected. Results showed where difficulties were expected. Results showed that no serious navigation problems should arise in the Jordan Reservoir and in the entrance to the diversion canal. Navigation conditions could be hazardous through the Bouldin reservoir when the pool is below elevation 248.00 ft. due to high velocities and crosscurrents. Tows with sufficient power to overcome the high velocity currents could negotiate the powerhouse tailrace and lower lock approach channel without serious difficulties. Lock emptying and start up of powerhouse units would create surges that would be hazardous to navigation within the lock approach channel and in the reach downstream to below the confluence of the tailrace and the Alabama River. Surges hazardous to navigation could also develop when closing down one or more powerhouse units hazardous to navigation could also develop whe closing down one or more powerhouse units.

NAVIGATION CONDITIONS AT MITCHELL LOCK AND DAM, COOSA RIVER, ALABAMA, National Oceanic and Atmospheric Administra-tion, Seattle, WA. Pacific Marine Environmental

C. M. Myrick.

Technical Report HL-84-12, December, 1984. Final Report. 70 p, 14 Fig, 9 Tab, 31 Plates.

Descriptors: *Locks, *Model studies, *Design cri-teria, *Navigation. Structural models, Models, Planning, Structural engineering, Dams, Hydraulic structures, Gates, Hydraulic gates.

A fixed-bed model reproducing about 4 miles of the Coosa River and adjacent overbank areas to an undistorted scale of 1:120 was used to provide data on navigational conditions with the proposed lock (Mitchell Lock). Results of the study showed that with medium to high flows, navigation conditions at the Highway 22 Bridge would be hazardous for both upbound and downbound tows due to the high velocities and limited width provided through the navigation soan with the existing piers and low the navigation span with the existing piers and low superstructure. With the first and second lock alignments, navigation conditions were acceptable with the 35,000 cu ft/sec flow only. With the third with the 35,000 cu ft/sec flow only. With the third lock alignment, navigation conditions were acceptable for all flows evenly distributed through the gated dam up to and including the 90,000 cu ft/sec flow. Flows unevenly distributed through the gated dam could cause navigation problems in the lower pool. Navigation conditions would be hazardous for tows in the upper lock approach canduluring lock filling or at the end of the lower guard wall when emptying the lock into the lower approach with no riverflow. This problem could be eliminated by a riverflow of 35,000 cu ft/sec or by emptying the lock into the river.

W86-0017 PROGRAM CRITERIA SPECIFICATIONS DOCUMENT: COMPUTER PROGRAM TWDA FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS, Army Engineer Div. Lower Mississippi Valley, Vicksburg, MS.

V. M. Agostinelli, W. A. Price, and C. E. Pace. February 1981. Final Report. 217 p, 10 Fig, 12

Descriptors: *Structural engineering, *Soil mechanics, *Computer programs, *Design criteria, *Retaining walls, Walls, Load distribution, Stability analysis, Earth pressure, Soil properties, Hydrostatic pressure, Seepage, Soil properties, Shear, Friction, Compressive strength, Earthquake engineering, Seismic properties, Water pressure, Reinforced concrete, Concrete, Stress, TWDA programs

This document presents criteria prepared as the basis for developing TWDA (T-wall design/analysis), a computer program for design and analysis of inverted-T cantilever walls founded on earth or rock. These structures can act as floodwalls or rock. These structures can act as floodwalls or retaining walls. The program is a series of design or analysis modules, each performing one specific step. Data are of two types: basic and load case. Stability criteria are the most uncertain and among the most important data used in design of an inverted-T wall. Other criteria are applied pressures (earth, overturning and sliding, hydrostatic, surcharge, and seepage), overturning stability, sliding, bearing pressures, earthquake analysis, and structural design (stress, reinforcing steel, stem loadings). ings). W86-00193

CLEVELAND HARBOR, OHIO: DESIGN FOR THE SAFE AND EFFICIENT PASSAGE OF 1,000-FT-LONG VESSELS AT THE WEST (MAIN) ENTRANCE, HYDRAULIC MODEL

INVESTIGATION,
Army Engineer Waterways Experiment Station,
Vicksburg, MS. Hydraulics Lab.
R. R. Bottin.

Technical Report HL-83-6, March 1983. Final Report. 346 p, 8 Fig, 34 Tab, 170 Photos, 20 Plates, 21 Ref, 2 Append.

Descriptors: *Breakwaters, *Navigation, *Waves, Cleveland Harbor, Ohio, Lake Erie, Model studies, Hydraulic models, Water currents, Channel im-provement, Transportation, Ships.

A 1:100-scale hydraulic model of Cleveland Harbor, Ohio, was used to investigate the effects of proposed improvements on ship maneuverability, wave and current action, and river flow conditions. Proposed changes included removal of portions of the existing breakwater spurs, deepening and widening of the existing channel, installation of additional breakwaters, and modifications of existing arrowhead breakwaters. Results indicated that existing conditions are characterized by rough and turbulent waves during storms, making the west entrance unsafe for 1000-ft long ore carriers. For safe passage of the 100-ft ships in fair weather, the east and west breakwater spurs should be reduced in length by 200 ft and 300 ft, respectively. However, this alteration would increase wave heights in the Lakefront Harbor. The optimum crest elevation of the west arrowhead breakwater should be 14 ft (10 ft if the structure is sealed). The optimum plan for severe weather conditions (thus for all wave conditions) consisted of removal of 300 ft of the existing west spur breakwater and 200 ft of the existing west spur breakwater and 200 ft parallel extension of the east and west arrowhead breakwaters.

CHANNEL CONTROL STRUCTURES FOR SOURIS RIVER, MINOT, NORTH DAKOTA: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. P. A. Saunders, and J. L. Grace. Technical Report HL-81-3, April 1981. Final Report. 57 p, 9 Fig, 1 Tab, 17 Photos, 16 Plates.

Descriptors: *Hydraulics, *Erosion control, *Channels, *Gabions, Riprap, Model tests, Hydraulic models, Souris River, North Dakota, Ice, Flow characteristics, Bank stabilization.

Model tests of channel control structures constructed of concrete and gabions were conducted at an undistorted scale ratio of 1:12 to determine the discharge characteristics of the structures, size and extent of riprap required to prevent scour downstream of the structures, effects of ice flowing over the structures, and stability of the gabion structures. The gabion structure was located in a typical section of trapezoidal channel, and a stable gabion configuration was developed by extending the gabions farther up the side slopes and farther downstream of the structure than was indicated in the original design. The concrete structure was placed in an expanded section of trapezoidal channel with riprap protection on the slide slopes and on the channel bottom upstream and downstream of the structure. Model results indicated that the original size and extent of protection could be of the structure. Model results indicated that the original size and extent of protection could be reduced without endangering the structure. Free and submerged flow discharge characteristics were determined for both types of channel control structures tested, and stability criteria were developed for the gabion structures. (Author) W86-00209

TECHNIQUE TO OPTIMALLY LOCATE MUL-

TILEVEL INTAKES FOR SELECTIVE WITH-DRAWAL STRUCTURES, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. M. S. Dortch, and J. P. Holland. Technical Report HL-84-9, November 1984, Final

Technical Report HL-84-9, November 1984. Final Report. 34 p, 11 Fig. 4 Tab, 5 Plates, 8 Ref, Append.

Descriptors: *Hydraulic structures, *Dams, *Reservoirs, *Outlets, *Intakes, *Water quality control, Optimization, Mathematical models, Model studies, Beltzville Dam, Design criteria.

A systematic procedure is given for designing an optimum selective withdrawal intake configuration for a reservoir outlet works. A reservoir thermal simulation model was coupled with a mathematical optimization algorithm to develop the optimal vertical placement of intakes and to minimize the total number of intakes. The simulation/optimization technique was applied to a specific case: the selective withdrawal intake structure at Belzville Dam on the Pohopoco Creek, Pennsylvania. Two mathematical optimization techniques were tested. The cyclic coordinate search with the Golden Section line search proved more suitable than Powell's method. method. W86-00213

FLOOD CONTROL MINNESOTA RIVER, MINNESOTA, MANKATO-NORTH MANKA-TO-LEHILLIER: DESIGN MEMORANDUM NO. 8, PART I (LOCATION STUDY).

NO. 8, PART I (LOCATION STUDY), Army Engineer District, St. Paul, MN. Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120868. Main Street Trunk Highway 60 Bridge over the Minnesota River between Mankato and North Mankato. Includes the Draft Supplement to the Final Environmental Impact Statement for Bridge Locations. June 1981. 294 p, 10 Fig, 13 Tab, 5

Descriptors: *Hydraulic structures, *Environmental effects, *Bridges, *Flood control, Highways, Minnesota River, Mankato, Socal impact, Minnesota

Flood control works are being constructed on the Minnesota and Blue Earth Rivers, Minnesota, to protect developed portions of Mankato, North Mankato, and Le Hillier from frequent flood damage. This report details the engineering studies for the modification to the Main Street bridge, which must be raised or replaced to an elevation of 30 ft above the existing bridge. The tentative plan would produce adverse neighborhood impacts in Mankato.

W86-00238 Mankato. W86-00238

WAVE STABILITY STUDY OF RIPRAP-FILLED CELLS: HYDRAULIC MODEL INVES-

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. D. G. Markle. Miscellaneous Paper HL-83-2, April 1983. Final Report. 59 p, 43 Fig, 1 Tab, 18 Plates.

Descriptors: *Erosion control, *Soil mechanics, *Riprap, *Wave action, *Bank protection, Bank stabilization, Stream stabilization, Hydraulic models, Model studies, Wave runup.

Both two-dimensional and three-dimensional hydraulic model investigations were conducted to test the stability of a new streambank protection concept when exposed to short-period wave attack. The concept, referred to as 'Riprap-Filled Cells,' consists of containerizing riprap in various sizes of cells. Based on the 1:4-scale (model:prototype) model tests and results for the 'riprap-filled cells' placed on IV-on-2H streambank slopes that are assumed to be stable and impermeable and for angles of wave attack of 90, 60, and 30 degrees, it is concluded that: (a) one-fi-cube cells (full and half-full of 0.6- to 4.6-lb riprap) are stable (no streambank exposure) for 2.0-sec, 1.0- to 1.75-ft, 4.0-sec, 1.0- to 1.5-ft nonbreaking waves; (b) rectangular cells (half-full of 0.6- to 4.6-lb riprap) are stable for nonbreaking wave heights up to and including 1.5 ft for wave periods of 2.0 and 6.0 sec. Wave heights exceeding this produce spot exposures of the streambank; (c) rectangular cells (full of 0.6- to 4.6-lb riprap) are stable for nonbreaking waves up to and including, 2.0 ft. Wave heights exceeding 2.0 ft produced spot exposures of the streambank; (d) both runup and rundown on all sections tested appear to be functions of wave steepness, relative depth, and angle of wave stake. The angles of wave attack, listed in descending magnitudes of runup and rundown produced, are 60, 90, and 30 degrees. One-ft-cube cells, full of riprap, and rectangular cells, half-full of riprap, and the rectangular cells, full of riprap. (Author) W86-00283

8B. Hydraulics

B-JUMPS AT ABRUPT CHANNEL DROPS Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.

W. H. Hager.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 861-866, May, 1985. 6 Fig. 7 Ref.

Descriptors: *Hydraulic jump, *Pressure distribu-tion, Channel flow, Channels, Fluid mechanics, Stilling basins, Mathematical equations.

Hydraulic jumps are one of the most frequently used energy dissipators. Its simplest form, the palne hydraulic jump occurs in rectangular, pris-matic, and almost horizontal channels. Whenever matic, and almost horizontal channels. Whenever using hydraulic jumps as a kinetic energy dissipator, one has to control carefully its stability under all possible flow conditions, which may be achieved by stilling basins, by which the jump is forced to appear at a particular location. B-jumps in rectangular, prismatic stilling basins consisting of an abrupt drop of the channel bottom are investigated by accounting for the effective pressure distribution and the internal flow process. The traditional approach is modified to yield a more accurate relation for the conjugate flow depths. An equation is proposed which agrees favorably with observations when the pressure distribution at the drop is properly accounted for. (Baker-IVI)

WATER SURFACE AT CHANGE OF CHANNEL

CURVATURE, Alberta Univ., Edmonton. Dept. of Civil Engi-P. M. Steffler, N. Rajaratnam, and A. W. Peterson.

Journal of Hydraulic Engineering, Vol. 111, No. 5, p 866-870, May, 1985. 1 Fig, 4 Ref.

Descriptors: *Hydraulic engineering, *Water surface, *Channel flow, *Curves, Froude number, Channels, Model studies, Open channels.

In most work on the problem of flow in curved In most work on the problem of flow in curved open channels, the lateral water surface slope has been assumed to be an algebraic function of the local channel curvature. Inspection of experimental water surface profiles indicates that an adjustment length in the order of the channel width is required where the curvature changes abruptly. A simple model is presented for the water surface configuration in the vicinity of an abrupt change in channel curvature taking free surface effects into account. The flow is assumed frictionless and the curvature is assumed mild. A simple expression for the length of such a transition as a function of Froude number has also been presented. The predicted water surface topography was shown to agree reasonably well with a few preliminary experiments. (Baker-IVI)

STORM SEWER OPTIMUM DESIGN,

D. Hoang.
In: Proceedings of Stormwater and Water Quality
Model User Group Meeting, January 27-28, 1983,
University of Florida, Gainesville. p 272-280, 1
Fig. 3 Tab.

Descriptors: *Storm sewers, *Design criteria, *Models, *Optimization, *Hydraulic models, *Sewer systems, *Cost-benefit analysis, *Hydraulic design, Model studies, Comparison studies, Sewers, Hydrographs, Runoff, Infiltration, Design Flow.

The STORM SEWER OPTIMUM DESIGN is a computer model which provides a fast means for estimating the optimum sewer system features for the least construction costs. The model is comthe least construction costs. The model is composed of a hydrograph computation compartment and design-flow compartment which coordinate to fully utilize the final sewer system. The OPTI-MUM DESIGN method uses the real rainfall in selecting design and calculates the costs of sewer components to make cost-benefit analyses of alternative routes easy and effective. The model contains features for the automatic numbering of manholes and sewer lines and for the extension of existing sewer systems to make storm sewer design more flexible. The OPTIMUM DESIGN method can accommodate users with less extensive engineering backgrounds than usually required of users of the Rational Method for storm sewer design. W86-00100 W86-00100

POINTE COUPEE PUMPING STATION SUMP AND OUTLET STRUCTURE, UPPER POINTE COUPEE LOOP AREA, LOUISIANA: HY-DRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 8C. W86-00101

ENERGY LOSSES AT STRAIGHT-FLOW-THROUGH SEWER JUNCTIONS, National Water Research Inst., Vancouver (British Columbia).

J. Marsalek.

Environment Canada, Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No. 111, 1981. 29 p, 9 Fig, 4 Tab, 13 Ref.

Descriptors: "Energy loss, "Sewer hydraulics, *Sewer systems, "Manholes, "Flow velocity, *Flow characteristics, "Pipe flow, "Hydraulics, Energy dissipation, Mathematical studies, Channel flow, Pipes, Pipelines.

Energy losses at straight-flow-through sewer junc-tions with free water surface were found to be considerably less than those in fully-pressurized pipe junctions without the free water surface. Mean energy losses observed for open-channel junctions were less than those for the same junc-

Field 8—ENGINEERING WORKS

Group 8B-Hydraulics

tions operating under pressure. There were only small differences in energy losses between square and circular manholes. Energy losses were less in manholes with installed benching. The junction energy loss coefficient was nearly doubled for manholes with a benching extending to the pipe crown. In sewers with closely spaced manholes, the overall system capacity may suffer marked energy losses. These may be compensated for by providing additional drops in the pipe invert. Such modifications are particularly important for surcharged sewer systems in which flow velocities and the corresponding junction energy losses may become appreciable. The energy loss coefficients presented in this report can provide data useful in the computerized calculation of pressurized flow. W86-00103

HYDRAULICS FOR OPERATORS,
Michigan Dept. of Public Health, Lansing. Section
of Water Supply.
W. E. Brown.
Water Testings Plant Co.

Water Treatment Plant Operations Series, Volume 3, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by V. W. Langworthy. 145 p.

Descriptors: *Hydraulics, *Hydrodynamics, *Flow characteristics, *Fluid mechanics, Orifices, Pipe flow, Channel flow, Flow measurement, Weirs, Manometers, Pumps, Pumping, Reviews.

This text is designed for trainees and personnel involved in water utility operations. Twelve lessons are presented on the flow of water and wastewater through pipes and channels, the use of pumps, and the effects of pressure exerted by water in a constructive or destructive fashion. Subject matter is presented in the simplest manner possible, and each lesson terminates with a list of problems and solutions for commonly encountered calculations or situations in the water utility field. The lessons presented are: hydraulic concepts, pressure, fundamentals of flow, pipe flow with friction loss, compound pipes, minor losses in fluid flow, flow in open channels, flow measurements, pump types and characteristics, and pumping. Lessons on the fundamentals of flow deal with head flow and Bernoulli's equation. Lessons on flow measurements deal with orifices, pipe flow, and Venturi meter, flow rate controls, manometers, weirs, other channel metering devices, and flow from the end channel metering devices, and flow from the end of a pipe. W86-00135

DIMENSIONS FOR SAFE AND EFFICIENT DEEP-DRAFT NAVIGATION CHANNELS: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.

Technical Report HL-84-10, December 1984. Final Report. 39 p, 27 Fig, 8 Ref.

Descriptors: *Model studies, *Design criteria, *Channel improvement, *Channel morphology, *Channels, *Navigation, Models, Watercourses, Planning, Telemetry.

Existing criteria for the design of deep-draft chan-nels were evaluated to determine if revisions could be made to channel dimensions. Free-running, remote-controlled model ships at a scale of 1:100 were used to examine deep-draft navigation chan-nel design methods. The tanker class of ships was used in the testing recorant because of the wide nel design methods. The tanker class of ships was used in the testing program because of the wide beam and slow response to rudder commands. The model ships were equipped with a video camera and telemetry instrumentation. Performance data concerning rudder angle, shaft rpm, and heading were also recorded and plotted. The straight reach tests were conducted at a depth to draft ratio of 1.2. The channel width dimension was narrowed until an unsafe condition existed. Results of model test for both one-way and two-way traffic showed that only a slight reduction in channel widths (about 10%) could be made. Additional safety factors should be allowed; however, revisions of the design criteria should not be based on the results of this study due to model scale effects and inaccuracies in the facility.

W86-00148

WEIR JETTY PERFORMANCE: HYDRAULIC AND SEDIMENTARY CONSIDERATIONS, HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 8A. W86-00152

BARCELONA HARBOR, NEW YORK, DESIGN FOR HARBOR IMPROVEMENTS: HYDRAU-LIC MODEL INVESTIGATION, Coastal Engineering Research Center, Vicksburg, MS.

For primary bibliographic entry see Field 8A. W86-00157

COMPUTER MODELING OF HYDRODYNA-MICS AND SOLUTE TRANSPORT IN CANALS AND MARINAS: LITERATURE REVIEW AND AND MARINAS: LITERATURE REVIEW AND GUIDELINES FOR FUTURE DEVELOPMENT, National Board of Waters, Helsinki (Finland). For primary bibliographic entry see Field 5B. W86-00179

CLEVELAND HARBOR, OHIO: DESIGN FOR THE SAFE AND EFFICIENT PASSAGE OF 1,000-FT-LONG VESSELS AT THE WEST (MAIN) ENTRANCE, HYDRAULIC MODEL

(MAIN) ENTRANCE, HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 8A. W86-00204

MEGEE CREEK PUMPING STATION SIPHON, PIKE COUNTY, ILLINOIS: HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.

R. R. Copeland.
Technical Report HL-82-23, September 1982.
Final Report. 73 p, 17 Fig, 6 Tab, 6 Photos, 25
Plates, 15 Ref.

Descriptors: *Hydraulic structures, *Siphons, *Flood control, *Pumping plants, MeGee Creek Pumping Station, Hydraulic models, Model studies, Saxophone siphon, Outlets, Hydraulic jump.

A 1:4.36-scale hydraulic model of the proposed McGee Creek pumping station siphon was used to develop a design with adequate hydraulic performance. The saxophone outlet design was modified to ensure maintenance of the priming seal. Priming times and head losses were measured in the model. Modifications to decrease priming times were tested, including a reduced cross-sectional area at the crown, and air escape vents. The recommended design siphon operated satisfactorily for the entire range of expected tailwaters and discharges. (Author) (Author) W86-00219

CHANNEL WIDTHS IN BENDS AND STRAIGHT REACHES BETWEEN BENDS FOR PUSH TOWING: HYDRAULIC MODEL IN-CHANNEL

PUSH TOWING: HYDRAULIC MODEL IN-VESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. L. J. Shows, and J. J. Franco. Technical Report HL-82-25, October 1982. Final Report. 38 p, 9 Fig. 4 Photos, 7 Plates.

Descriptors: *Hydraulic structures, *Transporta-tion, *Waterways, *Channel morphology, Naviga-ble waters, Towing, Hydraulic models, Model studies, Shallow water, Ships.

This investigation was concerned with the development of parameters that could be used as a guide in the layout and design of shallow-draft waterways, particularly bends and straight reaches between bends. Results are based largely on model studies using different linear scales and some limited prototype tests. In negotiating a bend or making

a turn, tows occupy a greater channel width than in straight reaches. The width of channel required depends on the deflection or drift angle which varies with the size of tow, radius of the bend or turn, length of the bend up to about 90 degrees, alignment and velocity of currents, weather conditions distorted for the straight (western or desirated of the straight (western or desirated or desirated of the straight (western or desirated or desirat alignment and velocity of currents, weather condi-tions, direction of travel (upstream or down-stream), draft of tow with respect to channel depth, alignment and location of the tow when entering the bend, and maneuverability of the tow. If the deflection angle assumed by a tow in negoti-ating a bend is known, the width of channel re-quired can be computed using one of the equations from this study. Results include curves showing from this study. Results include curves showing the deflection angle assumed by tows of various sizes in bends of different curvatures with and without currents. Also covered are bends consisting of compound curves, bends with irregular band lines, and lengths of straight reaches required between alternate bends. (Author) W86-00225

MISSION BAY HARBOR, CALIFORNIA, DESIGN FOR WAVE AND SURGE PROTECTION AND FLOOD CONTROL: HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.

C. R. Curren.

Technical Report HL-83-17, June 1983. Final Report. 314 p, 12 Fig, 28 Tab, 100 Photos, 72 Plates, 23 Ref, 3 Append.

Descriptors: *Hydraulic structures, *Waves, *Shore protection, *Flood control, *Breakwaters, Tides, Hydraulic models, Model studies, Mission Bay Harbor, San Diego River, California, Harbors, Navigation, Shoals, Jetties, Surges, Water currents, Channels, Wave height.

A 1:100-scale hydraulic model of the Mission Bay Harbor, California, area was used to study proposed structures for improving navigation conditions at the harbor entrance, reducing surges inside the harbor, and eliminating potential flood hazards from a sand plug in the San Diego River flood control channel. Two alternatives were found viable for protecting the harbor from waves and surges. Both involved an offshore 1600-ft breakwater. Tests of the present configuration in the channel showed that upstream flooding occurred at 97,000 cfs, the maximum flood flow, as well as at 49,000 cfs. Several alternatives reduced flooding: reducing the elevation of the sand plug, building a weir into the middle jetty. To prevent formation of the sand plug several methods were also effective: extension of the south jetty, construction of a pilot channel in the sand plug, and a diversion structure on the middle jetty. W86-00255 on the middle jetty. W86-00255

EDGEWATER MARINA, CLEVELAND, OHIO: DESIGN FOR WAVE PROTECTION, HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. R. R. Bottin, and H. F. Acuff. Technical Report. Hl-83-11, July 1983. Final Report. 79 p, 6 Fig, 6 Tab, 28 Photos, 14 Plates, 11 Ref, Append.

Descriptors: *Hydraulic structures, *Shore protec-tion, *Harbors, *Lakes, Breakwaters, *Waves, Navigation, Storms, Marinas, Cleveland Harbor, Edgewater Marina, Lake Erie, Hydraulic models, Model studies, Lake shores, Protection, Water cur-rents, Wave height.

A 1:100-scale model was used to evaluate planned improvements at Edgewater Marina, Cleveland Harbor, Lake Erie. These improvements were 23 combinations of the following: modifications to the harbor entrance and channel, installation of new breakwaters, modifications to the existing structures, and installation of rubble absorbers in the harbor. Several optimal improvement plans were chosen, and of which should reduce or eliminate hazardous wave-induced currents in the basin during boating season. Optimal plans were chosen

ENGINEERING WORKS—Field 8

Hydraulic Machinery-Group 8C

for the following scenarios: (1) new breakwater installed at the entrance and the east breakwater raised to 9.5 ft, (2) absorber installed at the entrance and east breakwater raised to 9.5 ft, (3) existing entrance closed and raised to 9.5 ft, east breakwater raised to 9.5 ft, and new entrance through the west breakwater, and (4) curved portion of the Edgewater breakwater replaced with randomly placed stone and east breakwater raised to 15 ft. W86-00256

DESIGN FOR PREVENTION OF BEACH ERO-SION AT PRESQUE ISLE BEACHES, ERIE, PENNSYLVANIA: HYDRAULIC MODEL IN-

PENISSILVANIA: HTDRAULIC MODEL IN-VESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. W. C. Seabergh. Technical Report HL-83-15, June 1983. Final Report. 315 p, 24 Fig, 4 Tab, 194 Plates, 10 Ref.

Descriptors: *Hydraulic structures, *Beaches, *Breakwaters, *Lakes, *Shore protection, Sediment transport, Wave action, Water currents, Groins, Model studies, Hydraulic models, Erosion control, lake shores, Presque Isle, Lake Erie.

Beach erosion at Presque Isle on Lake Erie was studied with a 1:50-scale hydraulic model. Various offshore breakwater plans were tested. Satisfactory results were obtained with 150-ft-long breakwaters with 350-ft spacing, regardless of groin presence or conformation. Tombolo development was dependent on proximity to groins, water level, wave height and period, crown elevation of the structure, distance of the breakwater from the initial shoreline, and sediment supply. Once a tombolo had attached to the breakwater, high water levels and waves overtopping the breakwater were required to erode the tombolo beachline back from the offshore breakwater. The strong longshore currents seen in the baseline tests were replaced by slower eddy-type currents behing the breakwaters. In large wave situations, currents moving lakeward between the breakwaters were diffused. Most sediment was retained shoreward of the line formed by the offshore breakwaters.

FUNCTIONAL DESIGN OF CONTROL STRUC-TURES FOR OREGON INLET, NORTH CARO-LINA: HYDRAULIC MODEL INVESTIGA-

TION,
Army Engineer Waterways Experiment Station,
Vicksburg, MS. Hydraulics Lab.
N. W. Hollyfield, J. W. McCoy, and W. C.
Seabergh.
Technical Report HL-83-10, June 1983. Final
Report. 458 p, 25 Fig, 11 Tab, 15 Photos, 365
Plates, 4 Ref.

Descriptors: "Hydraulic structures, "Breakwaters, "Channels, "Tidal effects, Manteo Bay Project, Oregon Inlet, North Carolina, Hydraulic models, Model studies, Jetties, Inlets, Waterways, Shoals, Navigation.

Control of shoaling and breaking waves in Oregon Inlet in North Carolina's Outer Banks was investigated by model testing. The model for the Manteo Bay Project had a 1:300 horizontal and 1:60 vertical scale. Testing included the study of jetty alignment, length, and spacing and the effects of jetty structures on tidal exchange and on the flow through Bonner Bridge. Steady-state ebb and flood storm surges were reproduced to study the effects of the jetties on these flows. Staged jetty construction tests helped to determine the best construction sequence to limit excessive scour velocities. Movable bed tests provided information on the effects of jetties on channel alignment for both normal tides and during storm surge conditions. A parallel two-jetty arrangement would not negatively impact the tidal exchange, storm surge flows, or flow through Bonner Bridge over the inlet. Spacings of 2500, 3500, and 5000 ft were all suitable. However, the large spacings may permit bifurcation of the entrance channel or a more curvilinear channel. W86-00269 W86-00269

WAVE DATA ACQUISITION AND HINDCAST FOR SAGINAW BAY, MICHIGAN, Army Engineer Waterways Experin Vicksburg, MS. Hydraulies Lab.

For primary bibliographic entry see Field 2H. W86-00282

BLOOMINGTON SPILLWAY NORTH BRANCH POTOMAC RIVER MARYLAND AND WEST VIRGINIA: HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.

B. P. Fletcher. Technical Report HL-83-9, June 1983. Final Report. 68 p, 11 Fig, 1 Tab, 8 Photos, 30 Plates.

Descriptors: *Hydraulic structures, *Spillways, *Dams, *Model studies, Hydraulic models, Bloomington Spillway, Potomac River, Gates, Dikes, Tainter gates, Eddies, Water currents, Flow pattern, Overburden, West Virginia, Maryland.

tern, Overburden, West Virginia, Maryland.

Tests to investigate hydraulic performance of the gated spillway and the intensity of return flow on the downstream side of the saddle dike were conducted using a 1:60-scale model. Flow approaching the spillway was satisfactory for all anticipated flow conditions. Eddies generated immediately upstream from the spillway had no significant effect on hydraulic performance. During controlled releases, no surging of flow at the abutments or atinter gates was observed. Model tests of the exit area were conducted with the overburden fixed and then movable. Tests conducted with the fixed overburden indicated that the maximum spillway flow of 178,000 cfs generated only an insignificant (4-ft depth at toe) amount of return flow toward the downstream toe of the saddle dike. Tests conducted with the movable overburden indicated significant displacement caused by a spillway flow of 10,000 cfs. Flows as great as 178,000 cfs caused additional displacement of overburden. The overburden did not scour upstream to the toe of the dike. Test results indicated that the safety of the saddle dike was not jeopardized by return flow with either the fixed or movable overburden simulated in the model. For any spillway flow condition, overburden material downstream from the spillway was transported through the swale and there was no tendency for a debris dam to form. (Author) (Author) W86-00285

GRAYS LANDING SPILLWAY AND STILLING BASIN, MONONGAHELA RIVER, PENNSYL-VANIA: HYDRAULIC MODEL INVESTIGA-

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. E. D. Rothwell, N. R. Oswalt, and S. T. Maynord. Technical Report HL-81-13, November 1981. Final Report. 78 p, 6 Fig. 8 Tab, 32 Photos, 12 Plates.

Descriptors: *Hydraulics, *Spillways, Stilling basins, *Reservoirs, *Dams, Hydraulic models Model studies, Grays Landing Spillway, Monon gahela River, Pennsylvania, Ice, Baffles, Design criteria, Energy dissipation, Locks, Riprap.

The hydraulic performance of the deeply submerged stilling basin for the Grays Landing spillway was studied on a 1:36-scale section model. The best design was a conventional hydraulic jump type energy dissipator which would perform well for both initial construction of one lock, a 576-ft-wide spillway crest and stilling basin, and the ultimate construction of two locks, a 460-ft-wide spillway crest and stilling basin. This design allowed the baffle blocks to be located farther downstream to prevent the ice from attacking the baffles and stilling basin apron. The recommended downstream riprap protection consisted of a 72-ft length of 30-inch riprap with a maximum stone weight of 1350 pounds, followed by a 108-ft length of 18-inch riprap with a maximum stone weight of 292 pounds. pounds. W86-00304

8C. Hydraulic Machinery

POINTE COUPEE PUMPING STATION SUMP AND OUTLET STRUCTURE, UPPER POINTE COUPEE LOOP AREA, LOUISIANA: HY-DRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Technical Report HL-83-3, March 1983. Final Report. 103 p, 20 Fig. 32 Tab, 18 photos, 8 plates.

Descriptors: *Models, *Model studies, *Pumps, *Hydraulic models, *Hydraulic equipment, *Design criteria, *Sumps, *Stilling basins, Hydrau-lic machinery, Performance evaluation, Pumping

Physical models were used to arrive upon a design that would afford optimum hydraulic performance of the Pointe Coupee pumping station sump and outlet structure. A sump design with umbrellas on the suction bells, converging sidewalls, and horizontal vortex supressor beams gave satisfactory sump performance for pumps with low submergence. The umbrellas significantly reduced surface vortices and pressure fluctuations by spreading the flow entering the suction bell. Converging sidewalls streamlined the flow lines entering the suction bell, thus reducing the swirl and the tendency to form surface vortices. The best location for the vortex suppressor beams was just above the upstream lip of the umbrella. Beams should extend approximately 1 ft into the flow and be about 1 ft apart. A hydraulic jump type stilling basin with baffles and divider walls was also developed. Riprap sizes were determined for the outlet channel downstream from the stilling basin. With these modifications, satisfactory sump performance was botts included the support of the substrace of the superson successions. modifications, satisfactory sump performance was obtained even for the adverse approach conditions that occur with single pump operations.

MEGEE CREEK PUMPING STATION SIPHON, PIKE COUNTY, ILLINOIS: HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.

For primary bibliographic entry see Field 8B. W86-00219

FLATIRON AGC INTERIM CONTROLLER-VOLUME IV, Bureau of Reclamation, Denver, CO. Engineering and Research Center. W. B. Gish, T. R. Whittemore, C. A. Lennon, and S. C. Stire.

S. C. Stitt. REC-ERC-84-6, March 1984. 167 p, 165 Fig, 2 Ref.

Descriptors: *Hydraulic machinery, *Electrical equipment, *Computers, *Control systems, *Automation, Flatiron Automatic Generation Controller, Controllers, Laramie River Power Station, Mt. Elbert Powerplant.

The Flatiron Interim Automatic Generation Controller has been placed in service for the Lower Missouri Western Area Power Administration Control Area. This controller controls the energy generation and transfers in northern Colorado, Wyoming, western Nebraska, western South Dakota, and southern Montana. The four-volume series details the design, construction, maintenance and operation of the master station and the remote stations. This volume contains all the hardware and software drawings for the first three volumes in the series, which document the master station system at the Dispatch Center, the Laramie River Power Station RTU, and at Mt. Elbert Powerplant RTU. W86-00223

BARKLEY DAM SPILLWAY TAINTER GATE AND EMERGENCY BULKHEADS, CUMBER-LAND RIVER, KENTUCKY: HYDRAULIC MODEL INVESTIGATION, eer Waterways Experiment Station,

Field 8-ENGINEERING WORKS

Group 8C—Hydraulic Machinery

Vicksburg, MS. Hydraulics Lab. J. E. Hite, and G. A. Pickering. Technical Report HL-83-12, August 1983. Final Report. 77 p, 9 Fig, 8 Tab, 12 Photos, 29 Plates.

Descriptors: "Hydraulic structures, "Dams, "Gates, "Spillways, Tainter gates, Spillway gates, Barkley Dam, Cumberland River, Kentucky, Locks, Navigation, Reservoirs, Model studies, Flow pattern, Stilling basins, Piers, Bulkhead gates.

Tests were conducted on 1:15- and 1:50-scale models to determine the cause of and to make modifications for eliminating tainter gate bouncing experienced under certain flow conditions at Barkley Dam. The 1:15-scale model determined the flow conditions that caused the bouncing, and the hydraulic loads and load variations acting on the gate during this occurrence. Hoist load fluctuations in excess of 140 kips were measured. The bottom of the tainter gate was modified to various configurations in an effort to alter the flow patterns causing the bouncing, but these modifications were relatively ineffective in reducing the hoist loads. A 1:50-scale model was incorporated into the study to determine the effect of the downstream spillway piers and the stilling basin on the flow conditions. Test results indicated that increasing the length of the spillway piers by 20 ft downstream reduced the surging of flow assiociated with the bouncing. A minimum top elevation of these extended piers was determined to be 345.0. The hoist loads were then measured with the piers placed in the 1:15-scale model. The maximum hoist load fluctuation was reduced by over 100 kips from 140 kips with the original design to 40 kips with the piers extended. The 1:15-scale model was also used to determine the hydraulic loads that occur as the emergency bulkheads are lowered under flowing water condi-The 1:15-scale model was also used to determine the hydraulic loads that occur as the emergency bulkheads are lowered under flowing water conditions. The bulkhead tests revealed that the loads on the hoist due to hydraulic forces were not extreme for heads on the gate still of 21, 29, and 34 ft as long as the bulkhead was lowered at the prototype hoisting speed of 4 to 6 ft/min. Unstable loads green encountered at heads of 29 and 34 ft on the gate sill when the bulkhead was held at stationary position above the crest with high tailwater conditions. (Author) tions. (Author)

8D. Soil Mechanics

PROGRAM CRITERIA SPECIFICATIONS DOCUMENT: COMPUTER PROGRAM TWDA FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS, Army Engineer Div. Lower Mississippi Valley, Vicksburg, MS. ary bibliographic entry see Field 8A. W86-00193

CHANNEL CONTROL STRUCTURES FOR SOURIS RIVER, MINOT, NORTH DAKOTA: HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 8A. W86-00209

LIST OF SOILS, SOIL-STRUCTURE INTERAC-TION AND OTHER RELATED COMPUTER PROGRAMS AVAILABLE FOR LMVD ENGI-

Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing

N. Radhakrishnana, and P. K. Senter. Technical Report K-81-1, May 1981. Final Report.

Descriptors: *Soil mechanics, *Computer programs, *Hydraulic structures, *Earthworks, T. walls, Slope stability, Retaining walls, Files, Seepage, Stress, Structural settlement, Piezometers, Messuring instruments, Surveying instruments, Data processing, Plotting, Finite difference methods, Earthquakes, Mississippi River Valley.

This report presents a list of soils, soil-structure interaction, and other related computer programs available for engineers of the Lower Mississippi Valley Division. Programs for use in the following subject areas are listed: T-walls; slope stability; piles, sheet piles, and cells; seepage; stress computation, settlement, and consolidation; piezometer data; instrumentation and laboratory data; plotting programs; finite element and finite difference methods; earthquakes and dynamics; and others. Also included are abstracts of some of the listed programs. (Author) grams. (Author) W86-00262

WAVE STABILITY STUDY OF RIPRAP-FILLED CELLS: HYDRAULIC MODEL INVES-

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 8A. W86-00283

8E. Rock Mechanics and Geology

SAND RESOURCES AND GEOLOGICAL CHARACTER OF LONG ISLAND SOUND, Coastal Engineering Research Center, Fort Belvoir, VA. S. J. Williams.

Technical Paper No. 81-3, May 1981. 65 p, 27 Fig, 5 Tab, 54 Ref, 2 Append. Project No. D31665.

Descriptors: *Shoals, *Beaches, *Shore protection, *Sediments, Marine sediments, Sand, Gravel, Long Island Sound, Connecticut, Dredging, Bottom sediments, Geology, Marine geology, Continental

Seismic profiles and vibratory cores were used to determine the geologic character of Long Island Sound. Fourteen isolated shoal features were identified as potential sources of beach fill sand and construction aggregate. About 189 million cu m of sand and gravel was estimated to be in water depths not exceeding 20 meters. Fifteen Connecticut beaches needing beach nourishment now and in the future were identified. Many parks and beaches on Long Island's north shore also may benefit from beach fill.

W86-00205 W86-00205

8F. Concrete

ENGINEERING CONDITION SURVEY OF CONCRETE IN SERVICE, Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab. R. L. Stowe, and H. T. Thornton. Technical Report REMR-CS-1, September 1984. Final Report. 109 p. 33 Fig. 69 Ref, 1 Append.

Descriptors: *Concrete technology, *Surveys, *Concrete testing, Evaluation, Structural engineering, Materials testing, Safety, Standards, Concrete construction, Rehabilitation.

construction, Rehabilitation.

Civil works structures must be continually evaluated for structural safety, stability, and operational adequacy. The overall objective of the investigation documented in this report is to develop information essential to the continued safety of concrete used in civil works structures such as flood control and multipurpose dams, navigation locks and dams, powerhouses and appurtenant structures, floodwalls, pumping stations, and similar structures. Specific objectives include (a) the development and evaluation of materials and techniques for repair and rehabilitation of civil works structures, (b) the development of engineering guidance to evaluate and monitor safety of structures, and (c) the development of design and construction methods for rehabilitating older structures to comply with current structural design criteria. A condition survey of a civil works structure includes a comprehensive review of the design of the structure, construction techniques and materials, and operational maintenance history. Information is ob-

tained from available engineering data on the structure as well as on-site investigations. Data are analyzed and an evaluation report is written which includes conclusions and/or repair recommendations. This report summarizes pertinent inspection procedures and methods of evaluation used by the Corps of Engineers in evaluating concrete civil works structures. Methods of evaluation include experience gained at the Waterways Experiment Station. Techniques are presented which have a potential for ascertaining the extent and cause of inadequacies in concrete structures. (Author) W86-00161

8G. Materials

SHORE STABILIZATION WITH SALT MARSH VEGETATION,
Coastal Engineering Research Center, Fort Bel-

Coastal Engineering Voir, VA.
P. L. Knutson, and W. W. Woodhouse.
Special Report No. 9, January 1983. 95 p, 38 Fig, 4
Tab, 94 Ref. Project No. D31234.

Descriptors: *Erosion control, *Estuaries, *Shore protection, *Marshes, *Vegetation, Fertilizers, Salt marshes, Wetland, Waves, Soil types, Sediments, Salinity, Particle size, Tidal marshes, Wind waves, Cordgrass, Spartina, Sedges, Rushes, Reeds, Mangrove, Environmental effects, Hairgrass.

grove, Environmental effects, Hairgrass.

Comprehensive guidelines are given on the use of marsh plants to control shore erosion from wind waves and tidal currents. Background information includes the role of marsh plants in erosion control, description of the natural coastal marshes by region, and the concept of encouraging marsh establishment to control shore erosion. Planting success depends on several factors. Soil type (cohesive or sandy) often dictates the choice of planting and fertilizer requirements. Some plants tolerate salinity up to the strength of sea water. Most marsh plants are adapted to anaerobic conditions. Exposure to direct sunlight must be assured by clearing woody vegetation 3-5 meters landward. The minimum planting width is about 6 meters. Sediment is beneficial to plantings. An evaluation form for evaluating a site for potential planting success uses shore characteristics (average and longest fetch, shoreline geometry, and sediment grain size). Smooth cordgrass (Spartina sloicosa) for the southern Pacific coast; and Lyngbye's sedge (Carex lyngbyei) and tufted hairgrass (Deschampsia aespitosa) for the northern Pacific coast. Plant materials, available as sprigs, pot-grown seedlings, and plugs, can be planted by hand, power-driven auger, or machine. sprigs, pot-grown seedlings, and plugs, can be planted by hand, power-driven auger, or machine. Fertilizers and application rates are given. Detailed planting specifications are described for a variety of plant species. Cost comparisons of erosion control methods and the potential benefits and disadvantages are summerized. vantages are summariz W86-00189

MODIFICATION OF BELL CANYON TEST MODIFICATION OF BELL CANYON TEST BECT1-FF GROUT, Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab. A. D. Buck, J. E. Rhoderick, J. P. Burkes, K. Mather, and R. E. Reinhold. Miscellaneous Paper SL-83-18, Report No. SAND 83-7097, September 1983. Final Report. 53 p, 24 Fig, 7 Tab, 6 Ref, 2 Append.

Descriptors: *Water quality control, *Grouting, *Water pollution prevention, *Radioactive waste disposal, Waste disposal, Cements, Bell Canyon, Boreholes, Fly ash, Silica fume, Physical properties, Chemical properties.

Bell Canyon Test (BCT) 1-FF grout was developed as a candidate material for use in repository sealing applications and was actually used in two field tests in New Mexico. This grout and modifications of it were made in the laboratory and tested or examined for workability, compressive strength, restrained expansion, permeability, phase composition, and microstructure. Most of these were done to an age of one year. Compressive

Preparation Of Reviews—Group 10F

strength and expansion data were determined beyond this age (960 days). Modifications included use of three other cements, two other fly ashes, a silica fume, different water contents, and different amounts of expansive additive (plaster). Each cement and mineral admixture was characterized by conventional chemical and physical tests as well as by X-ray diffraction examination. In general, the results indicated that the modifications to the basic BCT-1-FF grout produced other grouts that were as good as it. An exception to this was the grout mixture (M-8-C) made with shrinkage compensating expansive cement; it had an excessive flow time (> 20 sec). Another grout mixture (M-9-C) also had excessive flowtime and lower strength. It was thought that these problems could be solved with more modification to these two mixtures. (Author) W86-00248 W86-00248

PREVENTATIVE MEASURES TO LIMIT STRESS CORROSION CRACKING IN PRES-TRESSED CONCRETE, Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab. E. F. O'Neil. Miscellaneous Paper SL-83-14. September 1983.

Miscellaneous Paper SL-83-14, September 1983. Final Report. 15 p, 4 Fig, 8 Ref.

Descriptors: *Hydraulic structure, *Corrosion control, *Construction materials, *Concrete, *Steel, Coatings, Wires, Polymers, Stress, Cement, Metals, Grouting, Aggregates.

Preventive measures to minimize stress corrosion cracking of prestressed steel are reviewed. Al-though the mechanisms causing this type of corro-sion are little understood, several actions are help-

ful. Steel properties may be modified to reduce the tendency to corrode. Techniques to improve stress corrosion cracking are proper stress relieving of cold-drawn wire, new methods of quenching and tempering, decarbonizing the surface of the steel, shot peening, and lower final stress levels. Any method that can exclude corrosive gases and liquids also minimizes stress corrosion cracking. Factors in this category are a dense, low-permeability concrete (proper water-cement ratio), good concrete (proper water-cement ratio), good concrete workability, coarse aggregate material, proper vibration in compacting concrete, and longer cure time for concrete. Grouted prestressing systems can be designed with a suitable conduit and grout composition and application. Other methods of protecting steel wires are galvanization, plastic coatings, and polymer impregnated in the pore structure of the concrete.

W86-00249

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication **And Distribution**

IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COM-MUNITIES; VOLUME X: INDEX AND ADDEN-DUM TO VOLUMES I-VIII, Washington Univ., Seattle. Coll. of Forest Resources.

For primary bibliographic entry see Field 2I. W86-00254

ANNOTATED BIBLIOGRAPHY ON NORTH-ERN ENVIRONMENTAL ENGINEERING, 1978-1979,

Environmental Protection Service, Ottavio). Water Pollution Control Directorate. ental Protection Service, Ottawa (Ontar-B. C. Armstrong.

EPS 3-WP-81-4, July 1981. 100 p.

Descriptors: *Bibliographies, *Wastewater treatment, *Water treatment, *Cold regions, *Arctic, *Environmental engineering, Polar regions, Ice, Dams, Construction, Industrial wastes, Water pol-

An annotated bibliography on environmental engineering in northern regions is presented with key words and alphabetical subject index. This biennial words and alphabetical subject index. This biennial edition covers the literature from 1978 and 1979. Among the many subjects are wastewater collection and treatment, construction, dams, water treatment and distribution, environmental impact studies, freeze protection, ice growth, industrial wastes, soils, underground utilities, water pollution, and water supply. W86-00289

10F. Preparation Of Reviews

MICROBIOLOGICAL WATER QUALITY OF IMPOUNDMENTS: A LITERATURE REVIEW, Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences. For primary bibliographic entry see Field 5A. W86-00185

SUBJECT INDEX

ABSORPTION	New Concepts and Practices in Activated	ALDICARB
Tracer Applications of Ultra-Violet Absorption	Sludge Process Control,	Fate of Aldicarb, Aldicarb Sulfoxide, and Aldi-
Measurements in Coastal Waters,	W86-00221 5D	carb Sulfone in Floridan Groundwater,
W86-00056 2L	AGRICULTURAL RUNOFF	W86-00045 5B
ACID RAIN	Data Management for Continuous Hydrologic	ALGAE
Average Rainwater pH, Concepts of Atmos-	Simulation,	Phytoplankton-Environmental Interactions in
pheric Acidity, and Buffering in Open Systems,	W86-00093 2A	Reservoirs, Volume II: Discussion of Workshop
W86-00001 5B	Evaluation of Hydrologic Processes Affecting	Papers and Open Literature,
Economic Perspectives on Acid Deposition	Soil Movement in the Hagerman Fauna Area,	W86-00206 2H
Control.	Hagerman, Idaho,	ALGAE GROWTH
W86-00136 5G	W86-00119 2G	Point Sources-Nonpoint Sources Trading in the
Acid Rain: Does Science Dictate Policy or	Runoff, Sediment Transport, and Water Quality	Lake Dillon Watershed.
Policy Dictate Science,	in a Northern Illinois Agricultural Watershed	W86-00167 5B
W86-00137 6E	before Urban Development, 1979-81,	ALGAL GROWTH
Effect of Clobal Ontimination on Lecelly Onti	W86-00133 2J	Water-Quality Appraisal, Mammoth Creek and
Effect of Global Optimization on Locally Optimal Pollution Control: Acid Rain.	AGRICULTURAL WATERSHED	Hot Creek, Mono County, California,
W86-00138 6C	Runoff, Sediment Transport, and Water Quality	W86-00106 5A
	in a Northern Illinois Agricultural Watershed	ALGORITHMS
Economically Relevant Response Estimation	before Urban Development, 1979-81, W86-00133 2J	Two Algorithms For Parameter Estimation in
and the Value of Information: Acid Deposition, W86-00139 6B	W86-00133 2J	Groundwater Flow Problems,
W86-00139 6B	AGRICULTURAL WATERSHEDS	W86-00044 2F
Scientific Truths and Policy Truths in Acid	Data Management for Continuous Hydrologic	ATTIMIAT ACTUREDO
Deposition Research,	Simulation,	ALLUVIAL AQUIFERS Availability of Water from the Alluvial Aquifer
W86-00140 6B	W86-00093 2A	in Part of the Green River Valley, King County,
Normative Economics and the Acid Rain Prob-	AGRICULTURE	Washington,
lem,	Planning Guide for Evaluating Agricultural	W86-00126 2F
W86-00141 6B	Nonpoint Source Water Quality Controls,	47 mm - 1 mm - 0
Promote Instant of Asia Produktalon A. Co.	W86-00260 5G	ALPINE AREAS
Economic Impact of Acid Precipitation: A Ca- nadian Perspective,	Water and the City,	Comparison of Two Daily Streamflow Simula- tion Models of an Alpine Watershed,
W86-00142 6C	W86-00264 6D	W86-00033 2E
Acidification Impact on Fisheries: Substitution	Agricultural Water Demands, W86-00274 6D	ALPINE LAKES
and the Valuation of Recreation Resources,	W 80-002/4	Preliminary Evaluation of Lake Susceptibility to
W86-00144 5G	AIR POLLUTION	Water-Quality Degradation by Recreational Use, Alpine Lakes Wilderness Area, Washing-
Transferable Discharge Permits and Profit-Maxi-	Economic Perspectives on Acid Deposition	ton,
mizing Behavior,	Control.	W86-00114 5C
W86-00145 5G	W86-00136 5G	
Effects of Acid Rain on Soil and Water,	Acid Rain: Does Science Dictate Policy or	ALPINE REGIONS
W86-00166 2K	Policy Dictate Science,	Determination of Resistance Parameters of Pluvio-Nivo-Glacial Alpine Systems by Mathe-
	W86-00137 6E	matical Modeling of Runoff,
ACIDIC SOILS	Effect of Global Optimization on Locally Opti-	W86-00034 2E
Effects of Acid Rain on Soil and Water, W86-00166 2K	mal Pollution Control: Acid Rain,	12 (2011)
W 00-00100	W86-00138 6C	AMPHIBIANS
ACIDIC WATER	Economically Relevant Response Estimation	Large-Scale Operations Management Test of Use of the White Amur for Control of Problem
Effects of Acid Rain on Soil and Water,	and the Value of Information: Acid Deposition,	Aquatic Plants: The Herpetofauna of Lake
W86-00166 2K	W86-00139 6B	Conway, Species Accounts,
ACTIVATED SLUDGE		W86-00202 6G
New Concepts and Practices in Activated	Scientific Truths and Policy Truths in Acid Deposition Research,	ANAEROBIC DIGESTION
Sludge Process Control,	W86-00140 6B	Modeling of an ANFLOW Municipal Waste-
W86-00221 5D		Treatment Unit.
ACTIVATED SLUDGE PROCESS	Normative Economics and the Acid Rain Prob-	W86-00246 5D
New Concepts and Practices in Activated	lem, W86-00141 6B	1377447.5
Sludge Process Control,	W86-00141 6B	ANIMALS Large-Scale Operations Management Test of
W86-00221 5D	Economic Impact of Acid Precipitation: A Ca-	Use of the White Amur for Control of Problem
ADSORPTION	nadian Perspective,	Plants: Selected Life History Information of
Sediment-Water Interface in Modeling Pesti-	W86-00142 6C	Animal Species on Lake Conway, FL,
cides in Sedimentation Ponds,	Transferable Discharge Permits and Profit-Maxi-	W86-00197 4A
W86-00088 5B	mizing Behavior,	ANISOTROPIC MEDIA
ADVANCED WASTEWATER TREATMENT	W86-00145 5G	Dispersion in Anisotropic, Homogeneous,
Point Sources-Nonpoint Sources Trading in the	Laboratory Protocols for Evaluating the Fate of	Porous Media,
Lake Dillon Watershed.	Organic Chemicals in Air and Water,	W86-00015 2F
W86-00167 5B	W86-00154 5A	ANTIFOULING
ADVECTION	AT ACK A	Comparative Effectiveness of Antifouling Treat-
Analysis and Interpretation of Single-Well	ALASKA Sources, Composition, and Transport of Sus-	ment Regimes using Chlorine or a Slow-Releas-
Tracer Tests in Stratified Aquifers,	pended Particulate Matter in Lower Cook Inlet	ing Bromine Biocide,
W86-00074 2F	and Northwestern Shelikof Strait, Alaska,	W86-00063 5F
APRATION	W86-00150 2J	ABALACUICOLA BIVER
AERATION Hypolimnetic Aeration: Practical Design and	Opportunities to Brotant Instrum Plans in	APALACHICOLA RIVER Nitrogen and Phosphorus Speciation and Flux in
Application,	Opportunities to Protect Instream Flows in Alaska,	a Large Florida River Wetland System,
W86,00060 5G	W86-00280 6F.	W86-00080 2H

SUBJECT INDEX

AQUATIC ANIMALS

QUATIC ANIMALS Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems. 986-00230 5C	AQUATIC WEED CONTROL Improving Technology for Chemical Control of Aquatic Plants, W86-00183 4A	AUTOCORRELATION Gould's Probability Matrix Method; 2. The Annual Autocorrelation Problem, W86-00030 2E
Lakes and Microcosms: Extending Microcosm Data to Aquatic Ecosystems, W86-00231 5C	Large-Scale Operations Management Test of Use of the White Amur for Control of Problem Aquatic Plants: The Herpetofauna of Lake	AUTOMATION Flatiron AGC Interim Controller-Volume IV, W86-00223 8C
Optimum Microcosms for Lake Ecotoxicology, W86-00232 5C	Conway, Species Accounts, W86-00202 6G	BACTERIA Wastewater Reuse and Exposure to Legionella
QUATIC HABITATS	2,4-D Threshold Concentrations for Control of Eurasian Watermilfoil and Sago Pondweed,	Organisms, W86-00054 5C
Fishes of Selected Aquatic Habitats on the	W86-00208 4A	Passage of Selected Heavy Metals From Sphaer-
Lower Mississippi River, W86-00195 6G	AQUATIC WEEDS Proceedings, 16th Annual Meeting, Aquatic Plant Control Research Planning and Operations	otilus (Bacteria: Chlamydobacteriales) to Para- mecium caudatum (Protozoa: Ciliata), W86-00055 5C
Aquatic Habitat Studies on the Lower Mississip- pi River: River Mile 480-530; Report 3: Benthic Macroinvertebrate Studies Pilot Report,	Review. W86-00192 4A	Water-Quality Appraisal, Mammoth Creek and
W86-00212 6G	AQUIFER TESTING Analysis and Interpretation of Single-Well	Hot Creek, Mono County, California, W86-00106 5A
Aquatic Habitat Studies on the Lower Mississip- pi River: River Mile 480-530; Report 6: Larval Fish Studies Pilot Report,	Tracer Tests in Stratified Aquifers, W86-00074 2F	Sampling Frequency - Microbiological Drinking Water Regulations: Final Report, W86-00245 5A
W86-00226 6G	Water Resources on the Pueblo of Laguna, West-Central New Mexico,	BACTERIAL ANALYSIS
Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems.	W86-00108 2F	Microbiological Water Quality of Impound- ments: A Literature Review,
W86-00230 5C	Ground-Water Conditions in the Cottonwood- West Oakley Fan Area, South-Central Idaho,	W86-00185 5A
Lakes and Microcosms: Extending Microcosm Data to Aquatic Ecosystems,	W86-00117 2F Investigation of Waikele Well No. 2401-01,	Monitoring Marine Microbial Fouling. W86-00227 5A
W86-00231 5C	Oahu, Hawaii: Pumping Test, Well Logs and Water Quality,	BANK PROTECTION
Optimum Microcosms for Lake Ecotoxicology, W86-00232 5C	W86-00118 2K	Wave Stability Study of Riprap-Filled Cells: Hydraulic Model Investigation, W86-00283 8A
Chemicals and Wetlands,	AQUIFERS	
W86-00233 5C	Hydraulics of a Well Pumped with Linearly Decreasing Discharge, W86-00040 2F	BARIUM Removing Barium and Radium Through Calci-
Ecotoxicology at the Watershed Level,		um Cation Exchange, W86-00008 5F
W86-00234 5B	Analytical Solutions for Periodic Well Recharge in Rectangular Aquifers with Third-Kind	
Utility of Single Species and Ecosystem Tests in Assessing the Environmental Impact of Radio-	Boundary Conditions, W86-00041 2F	BASE FLOW Streamflow Losses Along the Balcones Fault Zone, Nucces River Basin, Texas,
nuclide Ecotoxicants, W86-00235 5B	Stratigraphy and Sedimentary Facies of the	W86-00124 2E
Classes of Ecotoxicological Tests: Their Advantages and Disadvantages for Regulation,	Madison Limestone and Associated Rocks in Parts of Montana, Nebraska, North Dakota,	BASELINE STUDIES Large-Scale Operations Management Test of
W86-00236 5C	South Dakota, Wyoming, W86-00104 2F	Use of the White Amur for Control of Problem Plants: Selected Life History Information of
Ecosystem Approach to the Toxicology of Resi- due Forming Xenobiotic Organic Substances in	Hydrogeologic and Water-Quality Characteris- tics of the Mount Simon-Hinckley Aquifer,	Animal Species on Lake Conway, FL, W86-00197 4A
the Great Lakes, W86-00237 5B	Southeast Minnesota, W86-00109 2K	BAYS Atchafalaya River Delta; Report 9: Wind Clima-
AQUATIC LIFE	Potential for Contamination of Shallow Aquifers	tology, W86-00163 2L
Utility of Single Species and Ecosystem Tests in Assessing the Environmental Impact of Radio-	in Illinois, W86-00178 5E	BEACH EROSION
nuclide Ecotoxicants, W86-00235 5B	ARCTIC Annotated Bibliography on Northern Environ-	Buhne Point, Humboldt Bay, California, Design for the Prevention of Shoreline Erosion: Hy-
Guide to Stream Habitat Analysis Using the Instream Flow Incremental Methodology,	mental Engineering, 1978-1979, W86-00289 10C	draulic and Numerical Model Investigations, W86-00169 4D
W86-00251 6G	AREAL PRECIPITATION	BEACHES
Ponds and Lagoons of Horn and Petit Bois Islands, Mississippi, Gulf Islands National Sea- shore: Their Physical Size, Literature Review	Areal Intensity-Duration-Frequency Curves: A Possible Way of Improving the Rainfall Input, W86-00095 2B	Sand Resources and Geological Character of Long Island Sound, W86-00205 8E
and Recommendations for Future Research, W86-00278 2H	W86-00006 4B	Effects of Beach Nourishment on the Nearshore Environment in Lake Huron at Lexington Harbor (Michigan),
Ethylene: Environmental and Technical Information for Problem Spills. W86-00303 5C	Effects on Groundwater Quality of the Intro-	W86-00224 6G Design for Prevention of Beach Erosion at
AQUATIC PLANTS	Effluent Recharge Site on the Chalk of Southern England.	Presque Isle Beaches, Erie, Pennsylvania: Hydraulic Model Investigation,
Release of Endothall from Aquathol Granular Aquatic Herbicide,	W86-00043 5D	W86-00257 8B
W86-00068 5G Effects of Oil on Seagrass Ecosystems,	AUSTRIA Seasonal Succession of Phytoplankton in Lake Constance,	BENTHIC FAUNA Long-Term Impact of Dredged Material Disposal in Lake Erie off Ashtabula, Ohio,
W86-00241 5C		W86-00162 5C

5C

BERING SEA	the West (Main) Entrance, Hydraulic Model In-	ture Review and Guidelines for Future Develop-
Dissolved Methane Concentrations in the South- east Bering Sea, 1980 and 1981,	vestigation, W86-00204 8A	ment, W86-00179 5B
W86-00180 2K	4	W86-00179 5B
	Mission Bay Harbor, California, Design for	CANOPY
BIBLIOGRAPHIES	Wave and Surge Protection and Flood Control:	Interception Storage Capacities of Tropical
Oil Shale Mining, Processing, Uses, and Envi- ronmental Impacts, 1978-July, 1981: Citations	Hydraulic Model Investigation, W86-00255 8B	Rainforest Canopy Trees,
from the NTIS Data Base.	W 00-00233	W86-00037 21
W86-00201 4C	Design for Prevention of Beach Erosion at	CARBON RADIOISOTOPES
11.00	Presque Isle Beaches, Erie, Pennsylvania: Hy-	Sorption Behaviour of 14C in Groundwater/
Oil Shale Mining, Processing, Uses, and Envi-	draulic Model Investigation, W86-00257 8B	Rock and in Groundwater/Concrete Environ-
ronmental Impacts, August, 1981-October, 1982: Citations from the NTIS Data Base.	W 80-00231 8B	ments,
W86-00215 5D	Functional Design of Control Structures for	W86-00184 5B
	Oregon Inlet, North Carolina: Hydraulic Model	CARBONATE MOUNDS
Annotated Bibliography on Northern Environ-	Investigation, W86-00269 8B	Stratigraphy and Sedimentary Facies of the
mental Engineering, 1978-1979, W86-00289 10C	W 80-00209 8B	Madison Limestone and Associated Rocks in
W 80-00289	BRIDGES	Parts of Montana, Nebraska, North Dakota,
BIOACCUMULATION	Stream Channel Stability Assessment, W86-00214 2J	South Dakota, Wyoming, W86-00104 2F
Heavy Metal Accumulation (Cd, Cu, Pb and	W86-00214 2J	W 50-00104 2F
Zn) by Smelt (Osmerus mordax) From the North Shore of the St Lawrence Estuary (Accu-	Flood Control Minnesota River, Minnesota,	CARBONATE ROCKS
mulation de Quelques Metaux Lourds (Cd, Cu,	Mankato-North Mankato-LeHillier: Design	Stratigraphy and Sedimentary Facies of the
Pb Et Zn) Chez L'Eperlan (Osmerus mordax)	Memorandum No. 8, Part I (Location Study).	Madison Limestone and Associated Rocks in
Preleve Sur La Rive Nord De L'Estuaire du	W86-00238 8A	Parts of Montana, Nebraska, North Dakota, South Dakota, Wyoming,
Saint-Laurent),	BRITISH COLUMBIA	W86-00104 2F
W86-00059 5C	Method of Predicting Daily Peak Flows in the	
Assessment of Heavy Metals and PCB's at Se-	High-Flow Season, W86-00027 2E	CARINENA
lected Sludge Application Sites in Ontario,	W86-00027 2E	Estimates of Peak Runoff from Hilly Terrain
W86-00102 5A	Estimation of Phosphorus Flux in a Regulated	with Varied Lithology, W86-00036 2E
BIOCIDES	Channel,	
Comparative Effectiveness of Antifouling Treat-	W86-00062 5A	CAROLINA BAYS
ment Regimes using Chlorine or a Slow-Releas-	BROMINE BIOCIDES	Locations and Areas of Ponds and Carolina
ing Bromine Biocide,	Comparative Effectiveness of Antifouling Treat-	Bays at the Savannah River Plant, W86-00263 2H
W86-00063 5F	ment Regimes using Chlorine or a Slow-Releas-	W86-00263 2H
BIOCONCENTRATION	ing Bromine Biocide, W86-00063 5F	CATCHMENT AREAS
Passage of Selected Heavy Metals From Sphaer-	W 80-00003	Hydrological Regionalisation: A Question of
otilus (Bacteria: Chlamydobacteriales) to Para-	BUFFERING	Problem and Scale,
mecium caudatum (Protozoa: Ciliata), W86-00055 5C	Average Rainwater pH, Concepts of Atmos-	W86-00096 2E
W 80-00033	pheric Acidity, and Buffering in Open Systems, W86-00001 5B	CATION EXCHANGE
BIOCONTROL		Removing Barium and Radium Through Calci-
Proceedings, 16th Annual Meeting, Aquatic	BUOYANT JETS	um Cation Exchange,
Plant Control Research Planning and Operations Review.	Surface Buoyant Jets in Steady and Reversing Crossflows.	W86-00008 5F
W86-00192 4A	W86-00014 5B	CE-QUAL-R1
		Coefficients for Use in the U.S. Army Corps of
BIOLOGICAL WASTEWATER TREATMENT New Concepts and Practices in Activated	CADMIUM	Engineers Reservoir Model, CE-QUAL-R1,
Sludge Process Control,	Heavy Metal Accumulation (Cd, Cu, Pb and Zn) by Smelt (Osmerus mordax) From the	W86-00153 5B
W86-00221 5D	North Shore of the St Lawrence Estuary (Accu-	CENSORED DATA
BIOTE ANGEODMATION	mulation de Quelques Metaux Lourds (Cd, Cu,	Statistical Choice of Extremal Models for Com-
BIOTRANSFORMATION Chlorinated Organics in Simulated Groundwater	Pb Et Zn) Chez L'Eperlan (Osmerus mordax)	plete and Censored Data,
Environments,	Preleve Sur La Rive Nord De L'Estuaire du Saint-Laurent),	W86-00026 2A
W86-00007 5B	W86-00059 5C	CENTRAL VALLEY
BLOCK-GEOMETRY FUNCTIONS		Regional Frequency Analysis of Multiyear
Block-Geometry Functions Characterizing	CALIFORNIA Analysis of Multimore	Droughts Using Watershed and Climatic Infor-
Transport in Densely Fissured Media,	Regional Frequency Analysis of Multiyear Droughts Using Watershed and Climatic Infor-	mation,
W86-00039 2F	mation,	W86-00025 2A
BOISE RIVER	W86-00025 2A	
Condensed Disaggregation Model for Incorpo-	Dynamic Model for Multireservoir Operation,	Dynamic Model for Multireservoir Operation,
rating Parameter Uncertainty Into Mouthly Res-	W86-00069 6A	W86-00069 6A
ervoir Simulations,		Quadratic Model for Reservoir Management:
W86-00073 2E	Quadratic Model for Reservoir Management: Application to the Central Valley Project.	Application to the Central Valley Project,
BOTTOM SEDIMENTS	W86-00070 6A	W86-00070 6A
Sediment-Water Interface in Modeling Pesti-		CHALK AQUIFER
cides in Sedimentation Ponds,	Water-Quality Appraisal, Mammoth Creek and	Effects on Groundwater Quality of the Intro-
W86-00088 5B	Hot Creek, Mono County, California, W86-00106 5A	duction of Secondary Sewage Treatment to an
BOUNDARY CONDITIONS		Effluent Recharge Site on the Chalk of Southern
Analytical Solutions for Periodic Well Recharge	CANALS	England,
in Rectangular Aquifers with Third-Kind	Historical Changes to Lake Washington and	W86-00043 5D
Boundary Conditions, W86-00041 2F	Route of the Lake Washington Ship Canal, King County, Washington,	CHANNEL EROSION
	W86-00105 2H	Review of Model Use in Evaluating Nonpoint
BREAKWATERS		Source Loads from Forest Management Activi-
Cleveland Harbor, Ohio: Design for the Safe and Efficient Passage of 1,000-ft-Long Vessels at	Computer Modeling of Hydrodynamics and Solute Transport in Canals and Marinas: Litera-	ties, W86-00091 5B
and antitution a monge of theoretic round a casets at	corne rimishori in camura and truming; Pricta.	

CHANNEL FLOW

HANNEL FLOW	CHEMICALS	Boulder Upslope Cloud Observation Experi-
Water Surface at Change of Channel Curvature, W86-00019 8B	Chemicals and Wetlands, W86-00233 5C	ment. W86-00261 2B
W86-00019 8B	W 60-00233	W 80-00201 2B
HANNEL IMPROVEMENT	CHEMISTRY OF PRECIPTATION	CLOUD SEEDING
Dimensions for Safe and Efficient Deep-Draft	Average Rainwater pH, Concepts of Atmos-	Cloud Physics Studies in the SCPP: Interim
Navigation Channels: Hydraulic Model Investi-	pheric Acidity, and Buffering in Open Systems,	Progress Report, 1983-84.
gation,	W86-00001 5B	W86-00305 3B
W86-00148 8B	CHLORINATED HYDROCARBONS	
Fishes of Selected Aquatic Habitats on the	Chlorinated Organics in Simulated Groundwater	Structure of Cold Fronts Over California,
Lower Mississippi River,	Environments,	W86-00306 3B
W86-00195 6G	W86-00007 5B	Responses to Seeding Clouds with Dry Ice in
N. C. H. VI. L I Change December Study	Francisco Assessables the Toriceless of Basi	the SCPP-1 Experiment,
Norfolk Harbor and Channels Deepening Study, Report 1: Physical Model Results, Chesapeake	Ecosystem Approach to the Toxicology of Resi- due Forming Xenobiotic Organic Substances in	W86-00307 3B
Bay Hydraulic Model Investigation,	the Great Lakes,	
W86-00266 2L	W86-00237 5B	COAGULATION
		Removal by Coagulation of Trace Organics
CHANNEL MORPHOLOGY	CHLORINE	from Mississippi River Water,
Dimensions for Safe and Efficient Deep-Draft	Comparative Effectiveness of Antifouling Treat-	W86-00011 5F
Navigation Channels: Hydraulic Model Investi-	ment Regimes using Chlorine or a Slow-Releas- ing Bromine Biocide,	COAL MINING
gation, W86-00148 8B	W86-00063 5F	Stream Water Quality in the Coal Region of
W 60-00146		Alabama and Georgia,
Stream Channel Stability Assessment,	CHLORINE DIOXIDE	W86-00250 5B
W86-00214 2J	Inactivation of Naegleria gruberi Cysts by Chlo-	
Channel Widths in Bends and Straight Reaches	rine Dioxide,	Stream Water Quality in the Coal Region of
Between Bends for Push Towing: Hydraulic	W86-00066 5F	West Virginia and Maryland,
Model Investigation,	CHLOROACETYLATION	W86-00253 5B
W86-00225 8B	Analysis of Phenols by Chemical Derivatization.	Stream Water Quality in the Coal Region of
	IV. Rapid and Sensitive Method for Analysis of	Ohio,
CHANNELS	21 Chlorophenols by Improved Chloroacetyla-	W86-00267 5B
Dimensions for Safe and Efficient Deep-Draft	tion Procedure,	77 00-00207
Navigation Channels: Hydraulic Model Investi- gation,	W86-00002 5A	Stream Water Quality in the Coal Region of
W86-00148 8B	CHLOROPHENOLS	Pennsylvania,
W 80-30140	Analysis of Phenols by Chemical Derivatization.	W86-00281 5B
Channel Control Structures for Souris River,	IV. Rapid and Sensitive Method for Analysis of	COACTAL AOUTEERS
Minot, North Dakota: Hydraulic Model Investi-	21 Chlorophenols by Improved Chloroacetyla-	COASTAL AQUIFERS
gation,	tion Procedure,	Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal
W86-00209 8A	W86-00002 5A	Aquifer,
Functional Design of Control Structures for	CLEANUP	W86-00042 2F
Oregon Inlet, North Carolina: Hydraulic Model	Winter Evaluation of Oil Skimmers and Booms.	11 00-000-12
Investigation,	W86-00290 5G	COASTAL WATERS
W86-00269 8B		Tracer Applications of Ultra-Violet Absorption
CHEMICAL ANALYSIS	CLEANUP OPERATIONS Restoration of Habitats Impacted by Oil Spills.	Measurements in Coastal Waters,
Multiresidue Method for the Analysis and Veri-	W86-00239 5C	W86-00056 2L
fication of Several Herbicides in Water,	11 00 00237	COLD REGIONS
W86-00046 5A	Recovery and Restoration of Rocky Shores,	Annotated Bibliography on Northern Environ-
	Sandy Beaches, Tidal Flats, and Shallow Subti-	mental Engineering, 1978-1979,
Sources, Composition, and Transport of Sus-	dal Bottoms Impacted by Oil Spills, W86-00240 5C	W86-00289 10C
pended Particulate Matter in Lower Cook Inlet and Northwestern Shelikof Strait, Alaska,	W86-00240 5C	
W86-00150 2J	Effects of Oil on Seagrass Ecosystems,	COLORADO
110000150	W86-00241 5C	Comparison of Two Daily Streamflow Simula-
Dissolved Methane Concentrations in the South-	Parameter and Parameter of Cale Mand	tion Models of an Alpine Watershed,
east Bering Sea, 1980 and 1981,	Recovery and Restoration of Salt Marshes and Mangroves Following an Oil Spill,	W86-00033 2E
W86-00180 2K	W86-00242 5C	Trend Analysis of Salt Load and Evaluation of
Procedures for Handling and Chemical Analysis		the Frequency of Water-Quality Measurements
of Sediment and Water Samples,	Measurements of Damage, Recovery, and Reha-	for the Gunnison, the Colorado, and the Dolores
W86-00198 5A	bilitation of Coral Reefs Exposed to Oil,	Rivers in Colorado and Utah,
CHEMICAL PROPERTIES	W86-00243 5C	W86-00123 5B
	CLIMATIC DATA	Water Resources Data for Colorado, Water
Effects of Acid Rain on Soil and Water, W86-00166 2K	Marine Weather of the Inland Waters of West-	Year 1982, Volume 2. Colorado River Basin
	ern Washington,	above Dolores River.
CHEMICAL REACTIONS	W86-00165 2B	W86-00128 7C
Average Rainwater pH, Concepts of Atmos-	CLIMATOLOGY	
pheric Acidity, and Buffering in Open Systems,	Designation of Madelines	COMBINED SEWER OVERFLOWS
W86-00001 5B	Droughts Using Watershed and Climatic Infor-	Flow Balancing Method for Stormwater and
Chemistry for Operators,	mation,	Combined Sewer Overflow.
W86-00134 5F		W86-00191 5D
CHEMICAL SPILLS	Andrefelous Bires Date Brown & Will & City	COMPUTER MODEL
Ethylene: Environmental and Technical Infor-	Atchafalaya River Delta; Report 9: Wind Clima- tology,	Ground-Water Resources of Audrain County.
mation for Problem Spills.	W86-00163 2L	Missouri,
W86-00303 5C		W86-00113 2F
	CLOUD PHYSICS	A 11 4 11
CHEMICAL WASTES	SCPP Data Collection and Analysis for the	Availability of Water from the Alluvial Aquifer in Part of the Green River Valley, King County,
Methods for Ecological Toxicology: A Critical Review of Laboratory Multispecies Tests.	Period 1 September 1981 through 31 August 1982,	Washington,
W86-00210 5C		W86-00126 2F

COMPUTER MODELS	CONFINED AQUIFERS	CURVES
Computer Simulation of an Industrial Wastewater Treatment Process, W86-00058 5D	Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal Aquifer,	Water Surface at Change of Channel Curvature, W86-00019 8B
Attempt to Implement SWMM in Tunisia, W86-00087 6A	W86-00042 2F CONSTRAINED LINEAR SYSTEM MODEL	CYSTS Inactivation of Naegleria gruberi Cysts by Chlo-
Some Recent Adaptations and Applications of	Nonlinear Time-Variant Constrained Model for Rainfall-Runoff,	rine Dioxide, W86-00066 5F
QUAL-II in the Northeast, W86-00090 5B	W86-00022 2A CONSTRUCTION MATERIALS	CYTOTOXICITY TESTING Rapidity of RNA Synthesis in Human Cells; A
Digital Simulation of the Regional Effects of Subsurface Injection of Liquid Waste near Pen- sacola, Florida,	Preventative Measures to Limit Stress Corrosion Cracking in Prestressed Concrete, W86-00249 8G	Highly Sensitive Parameter for Water Cytotoxi- city Evaluation, W86-00052 5A
W86-00122 5B		DAMS
SEDMNT: A Sediment Transport Submodel Based on Hydrodynamic Principles for the Uni-	CONTAMINATION Alternating Direction Galerkin Technique for Simulation of Contaminant Transport in Com-	Technique to Optimally Locate Multilevel Intakes for Selective Withdrawal Structures,
fied Transport Model, W86-00155 2J	plex Groundwater Systems, W86-00072 5B	W86-00213 8A
		Development of a Numerical Modeling Capabil- ity for the Computation of Unsteady Flow on
Preliminary User's Manual 3-D Mathematical Model of Coastal, Estuarine, and Lake Currents (CELC3D),	CONTROL SYSTEMS Flatiron AGC Interim Controller-Volume IV, W86-00223 8C	the Ohio River and Its Major Tributaries, W86-00220 2E
W86-00168 2E	COPPER	Barkley Dam Spillway Tainter Gate and Emer-
Computer Modeling of Hydrodynamics and Solute Transport in Canals and Marinas: Litera-	Heavy Metal Accumulation (Cd, Cu, Pb and Zn) by Smelt (Osmerus mordax) From the	gency Bulkheads, Cumberland River, Kentucky: Hydraulic Model Investigation,
ture Review and Guidelines for Future Develop- ment,	North Shore of the St Lawrence Estuary (Accumulation de Quelques Metaux Lourds (Cd, Cu,	W86-00284 8C Bloomington Spillway North Branch Potomac
W86-00179 5B COMPUTER PROGRAMS	Pb Et Zn) Chez L'Eperlan (Osmerus mordax) Preleve Sur La Rive Nord De L'Estuaire du	River Maryland and West Virginia: Hydraulic Model Investigation,
Coefficients for Use in the U.S. Army Corps of	Saint-Laurent), W86-00059 5C	W86-00285 8B
Engineers Reservoir Model, CE-QUAL-R1, W86-00153 5B	CORAL REEFS Measurements of Damage, Recovery, and Reha-	Grays Landing Spillway and Stilling Basin, Monongahela River, Pennsylvania: Hydraulic
SEDMNT: A Sediment Transport Submodel Based on Hydrodynamic Principles for the Uni-	bilitation of Coral Reefs Exposed to Oil, W86-00243 5C	Model Investigation, W86-00304 8B
fied Transport Model, W86-00155 2J	CORALS PARTY OF PARTY	DAPHNIA Toxicity to Daphnia of the End Products of Wet
User's Guide for a Plane and Axisymmetric Finite Element Program for Steady-State Seep-	Measurements of Damage, Recovery, and Rehabilitation of Coral Reefs Exposed to Oil, W86-00243 5C	Oxidation of Phenol and Substituted Phenola, W86-00064 5D
age Problems, W86-00156 2G	CORROSION CONTROL Preventative Measures to Limit Stress Corrosion	DATA ACQUISITION Wave Data Acquisition and Hindcast for Sagi-
Current Measurements in the Columbia River Estuary,	Cracking in Prestressed Concrete, W86-00249 8G	naw Bay, Michigan, W86-00282 2H
W86-00181 2L	COST ANALYSIS	DATA COLLECTIONS
Program Criteria Specifications Document: Computer Program TWDA for Design and	Effect of Global Optimization on Locally Optimal Pollution Control: Acid Rain,	Water Resources Data for Florida, Water Year 1981 Volume 1: Northeast Florida.
Analysis of Inverted-T Retaining Walls and Floodwalls,	W86-00138 6C	W86-00127 7C
W86-00193 8A	Economically Relevant Response Estimation and the Value of Information: Acid Deposition, W86-00139 6B	Water Resources Data for Colorado, Water Year 1982, Volume 2. Colorado River Basin
Hydrological Simulation Program-FORTRAN (HSPF): Users Manual for Release 8.0,	Scientific Truths and Policy Truths in Acid	above Dolores River, W86-00128 7C
W86-00199 2A Microcomputer Assisted Quality Assurance,	Deposition Research, W86-00140 6B	Water Resources Data, North Dakota, Water Year 1981, Volume 1. Hudson Bay Basin.
W86-00203 5A	Normative Economics and the Acid Rain Prob-	W86-00129 7C
List of Soils, Soil-Structure Interaction and	lem, W86-00141 6B	Water Resources Data Hawaii, Other Pacific Areas, Water Year 1981. Volume 2. Guam,
Other Related Computer Programs Available for LMVD Engineers, W86-00262 8D	Acidification Impact on Fisheries: Substitution	Northern Mariana Islands, Federated States of Micronesia, Palau Islands and American Samoa.
	and the Valuation of Recreation Resources, W86-00144 5G	W86-00130 7C
COMPUTERS Flatiron AGC Interim Controller-Volume IV.	COST-BENEFIT ANALYSIS	Natural Ground-Water-Recharge Data from
W86-00223 8C CONCRETE	Storm Sewer Optimum Design, W86-00100 8B	Three Selected Sites in Harvey County, South- Central Kansas, W86-00132 2F
Preventative Measures to Limit Stress Corrosion	CROSSFLOWS	
Cracking in Prestressed Concrete, W86-00249 8G	Surface Buoyant Jets in Steady and Reversing Crossflows,	Coefficients for Use in the U.S. Army Corps of Engineers Reservoir Model, CE-QUAL-R1, W86-00153 5B
CONCRETE TECHNOLOGY Engineering Condition Survey of Concrete in	W86-00014 5B CUMBERLAND RIVER BASIN	Dissolved Methane Concentrations in the South-
Service, W86-00161	Spatially Varying Rainfall and Floodrisk Analysis,	east Bering Sea, 1980 and 1981, W86-00180 2K
CONCRETE TESTING	W86-00012 2E	DATA INTERPRETATION
Engineering Condition Survey of Concrete in Service, W86-00161 8F	CURRENTS Initial Dilution for Outfall Parallel to Current, W86-00016 5B	Foundations of Principal Component Selection Rules, W86-00186 7C

DATA PROCESSING

DATA PROCESSING	DISPERSANTS	DRILLING FLUIDS
Foundations of Principal Component Selection	Fate of Chemically Dispersed Oil in the Sea: A	Results of an Adaptive Environmental Assess-
Rules, W86-00186 7C	Report on Two Field Experiments, W86-00172 5B	ment Modeling Workshop- Concerning Poten- tial Impacts of Drilling Muds and Cuttings on
W80-00180		the Marine Environment,
DEGRADATION	Measurements of Damage, Recovery, and Reha- bilitation of Coral Reefs Exposed to Oil,	W86-00147 5C
Chlorinated Organics in Simulated Groundwater Environments,	W86-00243 5C	DRINKING WATER
W86-00007 5B		AWWA Survey of Inorganic Contaminants in
	DISPERSION Dispersion in Anisotropic, Homogeneous,	Water Supplies.
DEPTH-AREA-DURATION ANALYSIS Areal Intensity-Duration-Frequency Curves: A	Dispersion in Anisotropic, Homogeneous, Porous Media,	W86-00009 5F
Possible Way of Improving the Rainfall Input,	W86-00015 2F	In-Home Treatment Methods for Removing
W86-00095 2B	Analysis and Interpretation of Single-Well	Volatile Organic Chemicals,
DESALINATION APPARATUS	Tracer Tests in Stratified Aquifers,	W86-00010 5F
High-Temperature Desalination Capability of	W86-00074 2F	DROUGHTS
TFC 1501 Reverse Osmosis Element,	DISSOLVED-AIR FLOTATION	Regional Frequency Analysis of Multiyear
W86-00265 3A	Advantages of Dissolved-Air Flotation for	Droughts Using Watershed and Climatic Infor-
DESIGN CRITERIA	Water Treatment,	mation, W86-00025 2A
Application of the STORM Model to Design	W86-00005 5F	W 80-00023
Problems in Singapore and in Kaosiung, Repub- lic of China,	DISSOLVED OXYGEN	DRYING FRONTS
W86-00086 6A	Some Recent Adaptations and Applications of	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called
Committee A Victor Donnell in Northern	QUAL-II in the Northeast, W86-00090 5B	Kanto Loam,
Snowmelt Induced Urban Runoff in Northern Sweden.	W 60-00090	W86-00038 2F
W86-00097 2C	Characterization of Aerobic Chemical Processes	DATE OF LOTHIC
Start Same Outline Parket	in Reservoirs: Problem Description and Model Formulation,	DYE-TRACING Time-of-Travel Data for Nebraska Streams,
Storm Sewer Optimum Design, W86-00100 8B	W86-00176 5B	1968 to 1977,
		W86-00120 2E
Pointe Coupee Pumping Station Sump and	DISTRIBUTION Variance of the T-year Event in the Log Pear-	EARTHWORKS
Outlet Structure, Upper Pointe Coupee Loop Area, Louisiana: Hydraulic Model Investigation,	son Type-3 Distribution,	List of Soils, Soil-Structure Interaction and
W86-00101 8C	W86-00031 2E	Other Related Computer Programs Available
Dimensions for Safe and Efficient Deep-Draft	DOCKS	for LMVD Engineers,
Navigation Channels: Hydraulic Model Investi-	Barcelona Harbor, New York, Design for	W86-00262 8D
gation,	Harbor Improvements: Hydraulic Model Inves-	EAST LAKE TOHOPEKALIGA
W86-00148 8B	tigation,	Groundwater Seepage Nutrient Loading in a
Navigation Conditions at Mitchell Lock and	W86-00157 8A	Florida Lake,
Dam, Coosa River, Alabama,	DOMESTIC WATER	W86-00065 2H
W86-00177 8A	Rainwater Catchment Water Quality in Micro-	ECOLOGICAL EFFECTS
Program Criteria Specifications Document:	nesia, W86-00061 3B	Techniques to Reduce the Sediment Resuspen-
Computer Program TWDA for Design and		sion Caused by Dredging, W86-00159 5G
Analysis of Inverted-T Retaining Walls and Floodwalls,	DRAINAGE BASINS Unit Hydrograph Approximations Assuming	The state of the s
W86-00193 8A	Linear Flow Through Topologically Random	Long-Term Impact of Dredged Material at Two
	Channel Networks,	Open-Water Sites: Lake Erie and Elliot Bay; Evaluative Summary,
DETECTION LIMITS Multiresidue Method for the Analysis and Veri-	W86-00082 2E	W86-00160 5C
fication of Several Herbicides in Water,	DRAINAGE ENGINEERING	
W86-00046 5A	Advancement in Hydraulic Modeling of Porous	Long-Term Impact of Dredged Material Dispos- al in Lake Erie off Ashtabula, Ohio,
DEVELOPING COUNTRIES	Pavement Facilities, W86-00098 2E	W86-00162 5C
Application of the STORM Model to Design	W86-00098 2E	D
Problems in Singapore and in Kaosiung, Repub-	DRAWDOWN	Restoration of Habitats Impacted by Oil Spills. W86-00239 5C
lic of China, W86-00086 6A	Ground-Water Resources of Audrain County, Missouri,	
	W86-00113 2F	Recovery and Restoration of Rocky Shores,
DIFFUSERS Initial Dilution for Outfall Parallel to Current,	DREDGING	Sandy Beaches, Tidal Flats, and Shallow Subti- dal Bottoms Impacted by Oil Spills,
W86-00016 5B	Techniques to Reduce the Sediment Resuspen-	W86-00240 5C
	sion Caused by Dredging,	F#
Initial Dilution for Outfall Parallel to Current,	W86-00159 5G	Effects of Oil on Seagrass Ecosystems, W86-00241 5C
W86-00016 5B	Long-Term Impact of Dredged Material at Two	the state of the s
Province	Open-Water Sites: Lake Erie and Elliot Bay;	Recovery and Restoration of Salt Marshes and Mangroves Following an Oil Spill,
DIOXINS Laboratory and Field Studies on the Fate of	Evaluative Summary,	W86-00242 5C
1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and		
Sediments,	Long-Term Impact of Dredged Material Dispos-	Measurements of Damage, Recovery, and Reha- hilitation of Coral Reefs Exposed to Oil
W86-00047 5B	al in Lake Erie off Ashtabula, Ohio, W86-00162 5C	bilitation of Coral Reefs Exposed to Oil, W86-00243 5C
DISCHARGE		The real beautiful and the second
Hydraulics of a Well Pumped with Linearly		Fisheries Resource Impacts from Spills of Oil or Hazardous Substances,
Decreasing Discharge, W86-00040 2F	Material, W86-00288 5A	W86-00244 5C
DISCHARGE MEASUREMENT Streamflow Losses Along the Balcones Faul	DREDGING SPOIL Long-Term Impact of Dredged Material Dispos-	ECONOMIC ASPECTS
Zone, Nueces River Basin, Texas,	al in Lake Erie off Ashtabula, Ohio,	Control.
W86-00124 2E		

Economic Impact of Acid Precipitation: A Ca-	ENERGY LOSS	EQUALIZING
nadian Perspective, W86-00142 6C	Energy Losses at Straight-Flow-Through Sewer Junctions,	Flow Balancing Method for Stormwater and Combined Sewer Overflow.
	W86-00103 8B	W86-00191 5D
Fisheries Resource Impacts from Spills of Oil or	ENGLAND	1157 ABOUT 12 174
Hazardous Substances, W86-00244 5C	Effects on Groundwater Quality of the Intro-	EROSION
W86-00244 5C	duction of Secondary Sewage Treatment to an	Mechanistic Simulation for Transport of Non-
ECONOMIC DEVELOPMENT	Effluent Recharge Site on the Chalk of Southern	point Source Pollutants, W86-00092 5B
Water and the City,	England,	W86-00092 5B
W86-00264 6D	W86-00043 5D	Evaluation of Hydrologic Processes Affecting
and the second		Soil Movement in the Hagerman Fauna Area,
ECOSYSTEMS	ENVIRONMENTAL EFFECTS	Hagerman, Idaho,
Working Papers Prepared as Background for	Results of an Adaptive Environmental Assess- ment Modeling Workshop- Concerning Poten-	W86-00119 2G
Testing for Effects of Chemicals on Ecosystems.	tial Impacts of Drilling Muds and Cuttings on	C. Cl. 10.17
W86-00230 5C	the Marine Environment,	Stream Channel Stability Assessment,
Lakes and Microcosms: Extending Microcosm	W86-00147 5C	W86-00214 2J
Data to Aquatic Ecosystems,		European and United States Case Studies in
W86-00231 5C	Fishes of Selected Aquatic Habitats on the	Application of the CREAMS Model.
response to the forest and the property of the	Lower Mississippi River,	W86-00294 5B
Optimum Microcosms for Lake Ecotoxicology,	W86-00195 6G	
W86-00232 5C	Large-Scale Operations Management Test of	CREAMS: A System for Evaluating Manage-
Ecotoxicology at the Watershed Level,	Use of the White Amur for Control of Problem	ment Practices on Field-Size Areas,
W86-00234 5B	Aquatic Plants: The Herpetofauna of Lake	W86-00295 5B
The state of the s	Conway, Species Accounts,	Testing the Application of CREAMS to Finnish
Utility of Single Species and Ecosystem Tests in	W86-00202 6G	Conditions,
Assessing the Environmental Impact of Radio-	Phytoplankton-Environmental Interactions in	W86-00296 5B
nuclide Ecotoxicants,	Reservoirs, Volume II: Discussion of Workshop	
W86-00235 5B	Papers and Open Literature,	Environmental Effects of Nitrogen Fertilization
Classes of Ecotoxicological Tests: Their Advan-	W86-00206 2H	Exemplified by Groundwater Pollution as Simu-
tages and Disadvantages for Regulation,		lated by CREAMS,
W86-00236 5C	Aquatic Habitat Studies on the Lower Mississip-	W86-00297 5B
W 50-50250	pi River: River Mile 480-530; Report 3: Benthic	Predicting Hillslope Runoff and Erosion in the
Ecosystem Approach to the Toxicology of Resi-	Macroinvertebrate Studies Pilot Report,	United Kingdom: Preliminary Trials with the
due Forming Xenobiotic Organic Substances in	W86-00212 6G	CREAMS Model,
the Great Lakes,	Effects of Beach Nourishment on the Nearshore	W86-00300 5B
W86-00237 5B	Environment in Lake Huron at Lexington	
Effects of Oil on Seagrass Ecosystems,	Harbor (Michigan),	Application of the CREAMS Model as Part of
W86-00241 5C	W86-00224 6G	an Overall System for Optimizing Environmen-
W 60-00241	Aquatic Unbited Studies on the Laure Mississis	tal Management in Lithuania, USSR: First Ex-
ECOTOXICOLOGY	Aquatic Habitat Studies on the Lower Mississip- pi River: River Mile 480-530; Report 6: Larval	periments, W86-00301 5B
Working Papers Prepared as Background for	Fish Studies Pilot Report,	W 60-00301
Testing for Effects of Chemicals on Ecosystems.	W86-00226 6G	Review of Case Studies of CREAMS Model
W86-00230 5C	although the second of the sec	Application,
walled a Add a blown to be a second	Working Papers Prepared as Background for	W86-00302 5B
Ecotoxicology at the Watershed Level,	Testing for Effects of Chemicals on Ecosystems.	
W86-00234 5B	W86-00230 5C	EROSION CONTROL
Utility of Single Species and Ecosystem Tests in	Ecotoxicology at the Watershed Level,	Planning and Implementation of Regional Stormwater Management Facilities in Montgom-
Assessing the Environmental Impact of Radio-	W86-00234 5B	ery County, Maryland,
nuclide Ecotoxicants,	the property of the second section of the section of	W86-00099 4A
W86-00235 5B	Utility of Single Species and Ecosystem Tests in	W 80-00022
	Assessing the Environmental Impact of Radio-	Buhne Point, Humboldt Bay, California, Design
Classes of Ecotoxicological Tests: Their Advan-	nuclide Ecotoxicants, W86-00235 5B	for the Prevention of Shoreline Erosion: Hy-
tages and Disadvantages for Regulation, W86-00236 5C	W86-00235 5B	draulic and Numerical Model Investigations,
W 80-00230	Classes of Ecotoxicological Tests: Their Advan-	W86-00169 4D
EFFLUENT LIMITATIONS	tages and Disadvantages for Regulation,	Shore Stabilization with Salt Marsh Vegetation,
Development Document for Effluent Limita-	W86-00236 5C	W86-00189 8G
tions Guidelines and Standards for the Textile	Flood Control Minnesota River, Minnesota,	W 05-00105
Mills Point Source Category.	Mankato-North Mankato-LeHillier: Design	Channel Control Structures for Souris River,
W86-00207 5G	Memorandum No. 8, Part I (Location Study).	Minot, North Dakota: Hydrautic Model Investi-
EVELLIENTS	W86-00238 8A	gation,
Nutrient Input from the Loxahatchee River En-		W86-00209 8A
vironmental Control District Sewage-Treatment	Guide to Stream Habitat Analysis Using the	Effects of Beach Nourishment on the Nearshore
Plant to the Loxahatchee River Estuary, South-	Instream Flow Incremental Methodology,	Environment in Lake Huron at Lexington
eastern Florida,	W86-00251 6G	Harbor (Michigan),
W86-00110 5B	ENVIRONMENTAL ENGINEERING	W86-00224 6G
	Annotated Bibliography on Northern Environ-	
ELECTRIC POWER INDUSTRY	mental Engineering, 1978-1979,	Wave Stability Study of Riprap-Filled Cells:
Industrial Water Demands,	W86-00289 10C	Hydraulic Model Investigation,
W86-00273 6D	PARTIDONAL PARTY IN COMPANY OF A TENANCE OF	W86-00283 8A
ELECTRICAL EQUIPMENT	ENVIRONMENTAL IMPACT STATEMENT Fisheries Resource Impacts from Spills of Oil or	ANSWERS (Areal Nonpoint Source Watershed
Flatiron AGC Interim Controller-Volume IV,	Hazardous Substances.	Environment Response Simulation) User's
W86-00223 8C	W86-00244 5C	
0F107-0F4/		W86-00287 4D
ENDOTHALL	ENVIRONMENTAL TRACERS	
Release of Endothall from Aquathol Granular	Tracer Applications of Ultra-Violet Absorption	ESTUARIES
Aquatic Herbicide,	Measurements in Coastal Waters,	Nutrient Input from the Loxahatchee River En-
W86-00068 5G	W86-00056 2L	vironmental Control District Sewage-Treatment

ESTUARIES

Plant to the Loxahatchee River Estuary, South- eastern Florida,	Sorption Behaviour of 14C in Groundwater/ Rock and in Groundwater/Concrete Environ-	Environmental Effects of Nitrogen Fertilization Exemplified by Groundwater Pollution as Simu-
W86-00110 5B	ments, W86-00184 5B	lated by CREAMS,
Quality of Water, Quillayute River Basin, Wash-	W80-00184	W86-00297 5B
ington, W86-00111 2K	User Guide for LARM2: A Longitudinal-Verti- cal, Time-Varying Hydrodynamic Reservoir	Application of the CREAMS Model for Calcu- lation of Leaching of Nitrate from Light Soils in
	Model,	the Notec River Valley,
Preliminary Appraisal of Sediment Sources and Transport in Kings Bay and Vicinity, Georgia	W86-00190 5B	W86-00298 5B
and Florida, W86-00125 2J	Hydrocarbons Associated with Suspended Matter in the Green River, Washington,	Application of the CREAMS Model: Western
W86-00125 2J	W86-00196 5B	Skane, Sweden, W86-00299 5B
Shore Stabilization with Salt Marsh Vegetation,	Washing Bases Bases of as Basksoned for	W 00-00255
W86-00189 8G Norfolk Harbor and Channels Deepening Study,	Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems. W86-00230 5C	Predicting Hillslope Runoff and Erosion in the United Kingdom: Preliminary Trials with the
Report 1: Physical Model Results, Chesapeake		CREAMS Model,
Bay Hydraulic Model Investigation,	Chemicals and Wetlands,	W86-00300 5B
W86-00266 2L	W86-00233 5C	Application of the CREAMS Model as Part of
Effects, Pathways, Processes, and Transforma- tion of Puget Sound Contaminants of Concern,	Ecotoxicology at the Watershed Level, W86-00234 5B	an Overall System for Optimizing Environmen- tal Management in Lithuania, USSR: First Ex-
W86-00293 5B	Utility of Single Species and Ecosystem Tests in	periments,
	Assessing the Environmental Impact of Radio-	W86-00301 5B
ESTUARINE ENVIRONMENT Effects of Spatial Variation in Amplitude and	nuclide Ecotoxicants,	Review of Case Studies of CREAMS Model
Phase of the Oscillatory Tidal Currents on the	W86-00235 5B	Application, W86-00302 5B
Residual Lagrangian Drifts, W86-00085 2L	Ecosystem Approach to the Toxicology of Resi-	
W 80-00083	due Forming Xenobiotic Organic Substances in the Great Lakes,	Ethylene: Environmental and Technical Infor-
THYLENE	W86-00237 5B	mation for Problem Spills. W86-00303 5C
Ethylene: Environmental and Technical Infor-		W 80-00303
mation for Problem Spills. W86-00303 5C	Leachate from Hazardous Wastes Sites, W86-00247 5B	FINITE DIFFERENCE METHODS
EL STRONG A TION	and the state of t	Preliminary User's Manual 3-D Mathematical Model of Coastal, Estuarine, and Lake Currents
EUTROPHICATION Water-Quality Appraisal, Mammoth Creek and	Stream Water Quality in the Coal Region of Alabama and Georgia,	(CELC3D),
Hot Creek, Mono County, California,	W86-00250 5B	W86-00168 2E
W86-00106 5A	Stream Water Quality in the Coal Region of	FINITE ELEMENT METHOD
EVAPORATION	West Virginia and Maryland,	Numerical Modelling of Subcritical Open Chan-
Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called	W86-00253 5B	nel Flow Using the K-epsilon Turbulence Model and the Penalty Function Finite Element Tech-
Kanto Loam,	Mathematical Model, SERATRA, for Sediment-	nique,
W86-00038 2F	Contaminant Transport in Rivers and Its Appli- cation to Pesticide Transport in Four Mile and	W86-00003 2E
Soil Water Evaporation Suppression by Sand	Wolf Creeks in Iowa.	FINLAND
Mulches, W86-00050 2G	W86-00259 5B	Testing the Application of CREAMS to Finnish Conditions,
A STATE OF THE PARTY OF THE PAR	Planning Guide for Evaluating Agricultural	W86-00296 5B
EXTREMAL MODELS Statistical Choice of Extremal Models for Com-	Nonpoint Source Water Quality Controls, W86-00260 5G	FISH
plete and Censored Data,		Heavy Metal Accumulation (Cd, Cu, Pb and
W86-00026 2A	Stream Water Quality in the Coal Region of Ohio,	Zn) by Smelt (Osmerus mordax) From the
FATE OF POLLUTANTS	W86-00267 5B	North Shore of the St Lawrence Estuary (Accu-
Fate of Aldicarb, Aldicarb Sulfoxide, and Aldi-	Company of the last of the Colons of	mulation de Quelques Metaux Lourds (Cd, Cu, Pb Et Zn) Chez L'Eperlan (Osmerus mordax)
carb Sulfone in Floridan Groundwater,	Stream Water Quality in the Coal Region of Pennsylvania,	Preleve Sur La Rive Nord De L'Estuaire du
W86-00045 5B	W86-00281 5B	Saint-Laurent),
Laboratory and Field Studies on the Fate of	Survey of Polychlorinated Biphenyls in Industri-	W86-00059 5C
1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and	al Effluents in Canada.	Review of the Effects of Water-Level Changes
Sediments, W86-00047 5B	W86-00286 5B	on Reservoir Fisheries and Recommendations
- COLD 205 (V)	ANSWERS (Areal Nonpoint Source Watershed	for Improved Management, W86-00158 6G
Release of Endothall from Aquathol Granular Aquatic Herbicide,	Environment Response Simulation) User's	
W86-00068 5G	Manual. W86-00287 4D	Fishes of Selected Aquatic Habitats on the Lower Mississippi River,
Sediment-Water Interface in Modeling Pesti-		W86-00195 6G
cides in Sedimentation Ponds,	Effects, Pathways, Processes, and Transforma- tion of Puget Sound Contaminants of Concern,	Aquatic Habitat Studies on the Lower Mississip-
W86-00088 5B	W86-00293 5B	pi River: River Mile 480-530; Report 6: Larval
Mechanistic Simulation for Transport of Non- point Source Pollutants.	European and United States Case Studies in	Fish Studies Pilot Report, W86-00226 6G
W86-00092 5B	Application of the CREAMS Model. W86-00294 5B	FISHERIES
Assessment of Heavy Metals and PCB's at Se-	CREAMS: A System for Evaluating Manage-	Acidification Impact on Fisheries: Substitution
lected Sludge Application Sites in Ontario, W86-00102 5A	ment Practices on Field-Size Areas,	and the Valuation of Recreation Resources, W86-00144 5G
	W86-00295 5B	
Laboratory Protocols for Evaluating the Fate of Organic Chemicals in Air and Water,	Testing the Application of CREAMS to Finnish Conditions,	Fisheries Resource Impacts from Spills of Oil or Hazardous Substances,
W86-00154 5A	W86-00296 5B	W86-00244 5C

FISHERIES MANAGMENT	Water Resources Data for Florida, Water Year	FRANCE
Hypolimnetic Aeration: Practical Design and Application.	1981 Volume 1: Northeast Florida. W86-00127 7C	Rapidity of RNA Synthesis in Human Cells; A Highly Sensitive Parameter for Water Cytotoxi-
W86-00060 5G		city Evaluation,
FLOOD CONTROL	FLOTATION Evaluation of the 'Lectro Clear Z' Electrocoa-	W86-00052 5A
Flood Damage Alleviation in New Jersey,	gulation Process for Meat Packing Wastewater	FREQUENCY ANALYSIS
W86-00173 6F	Treatment. W86-00252 5D	Regional Frequency Analysis of Multiyear
MeGee Creek Pumping Station Siphon, Pike	W86-00252 5D	Droughts Using Watershed and Climatic Infor-
County, Illinois: Hydraulic Model Investigation,	FLOW	mation, W86-00025 2A
W86-00219 8B	Dispersion in Anisotropic, Homogeneous, Porous Media,	
Flood Control Minnesota River, Minnesota,	W86-00015 2F	Areal Intensity-Duration-Frequency Curves: A Possible Way of Improving the Rainfall Input,
Mankato-North Mankato-LeHillier: Design Memorandum No. 8, Part I (Location Study).	Unit Hydrograph Approximations Assuming	W86-00095 2B
W86-00238 8A	Linear Flow Through Topologically Random	PERMITTE
Mission Boy Hosban Colifornia Davies for	Channel Networks, W86-00082 2E	FUNGUS Heterotrophic Slimes in Irish Rivers, Evaluation
Mission Bay Harbor, California, Design for Wave and Surge Protection and Flood Control:		of the Problem,
Hydraulic Model Investigation,	FLOW CHARACTERISTICS Energy Losses at Straight-Flow-Through Sewer	W86-00053 5B
W86-00255 8B	Junctions,	FUTURE PLANNING
FLOOD DAMAGE	W86-00103 8B	Present and Prospective Use of Water by the
Flood Damage Alleviation in New Jersey, W86-00173 6F	Hydraulics for Operators,	Manufacturing Industries of New Jersey,
	W86-00135 8B	W86-00175 6D
Poststorm Reconnaissance of Tropical Storm Chris.	Development of a Numerical Modeling Capabil-	GABIONS
W86-00279 2B	ity for the Computation of Unsteady Flow on	Channel Control Structures for Souris River, Minot, North Dakota: Hydraulic Model Investi-
FLOOD FORECASTING	the Ohio River and Its Major Tributaries, W86-00220 2E	gation,
Spatially Varying Rainfall and Floodrisk Analy-		W86-00209 8A
sis,	FLOW CONTROL Flow Balancing Method for Stormwater and	GATES
W86-00012 2E	Combined Sewer Overflow.	Barkley Dam Spillway Tainter Gate and Emer-
Method of Predicting Daily Peak Flows in the	W86-00191 5D	gency Bulkheads, Cumberland River, Kentucky:
High-Flow Season, W86-00027 2E	FLOW RATE	Hydraulic Model Investigation, W86-00284 8C
and a second of the second of the second	Water Resources Data Hawaii, Other Pacific	
FLOOD PLAIN MANAGEMENT	Areas, Water Year 1981. Volume 2. Guam, Northern Mariana Islands, Federated States of	GEOCHEMISTRY Karnes County, Texas, Area Hydrochemical and
Flood Damage Alleviation in New Jersey, W86-00173 6F	Micronesia, Palau Islands and American Samoa.	Stream Uranium Orientation Study,
WOOD WANTED TO STORE	W86-00130 7C	W86-00194 2K
FLOOD PLAIN ZONING Flood Damage Alleviation in New Jersey,	FLOW RATES	GEOGRAPHY
W86-00173 6F	Circulation in the Lower Cook Inlet, Alaska,	Analysis of the Effects of Orography on Surface
FLOODRISK ANALYSIS	W86-00149 2L	Rainfall by a Parameterized Numerical Model,
Spatially Varying Rainfall and Floodrisk Analy-	FLOW VELOCITY	W86-00023 2B
sis, W86-00012 2E	Energy Losses at Straight-Flow-Through Sewer Junctions,	GEOLOGICAL MAPPING
Service of Torong State of The	W86-00103 8B	Potential for Contamination of Shallow Aquifers in Illinois.
FLOODS Variance of the T-year Event in the Log Pear-	FLUID MECHANICS	W86-00178 5E
son Type-3 Distribution,	Hydraulics for Operators,	
W86-00031 2E	W86-00135 8B	GEORGIA Preliminary Appraisal of Sediment Sources and
Minimum Variance Streamflow Record Aug-	Preliminary User's Manual 3-D Mathematical	Transport in Kings Bay and Vicinity, Georgia
mentation Procedures,	Model of Coastal, Estuarine, and Lake Currents	and Florida, W86-00125
W86-00079 2E	W86-00168 2E	W86-00125
Hydrological Yearbook: 1980.	FOREST MANAGEMENT	GEOTHERMAL RESOURCE
W86-00182 2A	Review of Model Use in Evaluating Nonpoint	Analysis and Interpretation of Data Obtained in Tests of the Geothermal Aquifer at Klamatl
FLORIDA	Source Loads from Forest Management Activi-	Falls, Oregon,
Fate of Aldicarb, Aldicarb Sulfoxide, and Aldi- carb Sulfone in Floridan Groundwater.	ties, W86-00091 5B	W86-00107 2F
W86-00045 5B		GHYBEN-HERZBERG GROUNDWATER LENS
Groundwater Seepage Nutrient Loading in a	FOREST WATERSHEDS Review of Model Use in Evaluating Nonpoint	Investigation of Waikele Well No. 2401-01
Florida Lake,	Source Loads from Forest Management Activi-	Oahu, Hawaii: Pumping Test, Well Logs and Water Quality,
W86-00065 2H	ties,	W86-00118 23
Nitrogen and Phosphorus Speciation and Flux in		
a Large Florida River Wetland System,	FORMATION CONSTANTS	GLACIERS Runoff from Glacierized Mountains: A Mode
W86-00080 2H	Decreasing Discharge.	for Annual Variation and Its Forecasting,
Nutrient Input from the Loxahatchee River En	W86-00040 2F	W86-00077 21
vironmental Control District Sewage-Treatment Plant to the Loxahatchee River Estuary, South-		GOULD'S PROBABILITY MATRIX
eastern Florida,	Comparative Effectiveness of Antifouling Treat-	
W86-00110 5E		Starting Month Problem, W86-00029 21
Digital Simulation of the Regional Effects of		
Subsurface Injection of Liquid Waste near Pen- sacola, Florida,	Monitoring Marine Microbial Fouling.	Gould's Probability Matrix Method; 2. Th Annual Autocorrelation Problem,
W86-00122 5E		W86-00030 21

GRAIN CROPS

Assessment of Water Resources in Lead-Zinc	Instream Flow Incremental Methodology,
Mined Areas in Cherokee County, Kansas, and Adjacent Areas,	W86-00251 6G
W86-00121 5A	HARBORS Barcelona Harbor, New York, Design for Harbor Improvements: Hydraulic Model Inves-
Natural Ground-Water-Recharge Data from Three Selected Sites in Harvey County, South-	tigation, W86-00157 8A
Central Kansas, W86-00132 2F	Edgewater Marina, Cleveland, Ohio: Design for
GROUNDWATER MOVEMENT	Wave Protection, Hydraulic Model Investiga- tion, W86-00256 8B
Porous Media,	HARDY-CROSS NETWORK SOLVER
Block-Geometry Functions Characterizing	TECHNIQUE Optimal Urban Water Distribution Design,
Transport in Densely Fissured Media, W86-00039 2F	W86-00071 5F
Two Algorithms For Parameter Estimation in Groundwater Flow Problems, W86-00044 2F	Investigation of Waikele Well No. 2401-01, Oahu, Hawaii: Pumping Test, Well Logs and Water Quality,
Groundwater Seepage Nutrient Loading in a	W86-00118 2K
Florida Lake, W86-00065 2H	HEATED WATER Surface Buoyant Jets in Steady and Reversing Crossflows,
Water Resources on the Pueblo of Laguna, West-Central New Mexico,	W86-00014 5B
W86-00108 2F Ground-Water Resources of Audrain County.	Passage of Selected Heavy Metals From Sphaer-
Missouri, W86-00113 2F	otilus (Bacteria: Chlamydobacteriales) to Para- mecium caudatum (Protozoa: Ciliata), W86-00055
Seepage Analysis Using the Boundary Element	Heavy Metal Accumulation (Cd, Cu, Pb and
Method, W86-00228 2G	Zn) by Smelt (Osmerus mordax) From the North Shore of the St Lawrence Estuary (Accu-
GROUNDWATER POLLUTION One-Dimensional Analytical Solutions for the	mulation de Quelques Metaux Lourds (Cd, Cu Pb Et Zn) Chez L'Eperlan (Osmerus mordax; Preleve Sur La Rive Nord De L'Estuaire du
Migration of a Three-Member Radionuclide Decay Chain in a Multilayered Geologic Medium,	Saint-Laurent), W86-00059 50
W86-00081 5B	Assessment of Heavy Metals and PCB's at Se lected Sludge Application Sites in Ontario,
in Illinois,	W86-00102 5A
not be a second to the second	Long-Term Impact of Dredged Material Dispos al in Lake Erie off Ashtabula, Ohio, W86-00162 50
gan: Economic and Social Impacts of Ground- water Contamination; A Case Study in East Bay	W86-00162 50 HERBICIDES
Township, Grand Traverse County, Michigan. W86-00218 5C	Multiresidue Method for the Analysis and Veri fication of Several Herbicides in Water,
GROUNDWATER QUALITY Investigation of Waikele Well No. 2401-01,	W86-00046 5A Release of Endothall from Aquathol Granula
Oahu, Hawaii: Pumping Test, Well Logs and Water Quality,	Aquatic Herbicide, W86-00068 50
	Improving Technology for Chemical Control of
Uses of Recharge Wells in Water Supply,	Aquatic Plants, W86-00183
GROUNDWATER RESOURCES	Proceedings, 16th Annual Meeting, Aquati Plant Control Research Planning and Operation
Stratigraphy and Sedimentary Facies of the Madison Limestone and Associated Rocks in Parts of Montana, Nebraska, North Dakota,	Review. W86-00192 44
South Dakota, Wyoming, W86-00104 2F	2,4-D Threshold Concentrations for Control of Eurasian Watermilfoil and Sago Pondweed,
GROUTING Modification of Bell Canyon Test (BCT) 1-FF	W86-00208 4. HETEROTROPHIC SLIMES
Grout,	Heterotrophic Slimes in Irish Rivers, Evaluation of the Problem,
HABITATS	W86-00053
Large-Scale Operations Management Test of Use of the White Amur for Control of Problem	HISTORICAL SHORELINE Historical Changes to Lake Washington an
	Adjacent Areas, W86-00121 5A GROUNDWATER LEVEL Natural Ground-Water-Recharge Data from Three Selected Sites in Harvey County, South-Central Kansas, W86-00132 2F GROUNDWATER MOVEMENT Dispersion in Anisotropic, Homogeneous, Porous Media, W86-00015 2F Block-Geometry Functions Characterizing Transport in Densely Fissured Media, W86-00039 2F Two Algorithms For Parameter Estimation in Groundwater Flow Problems, W86-00044 2F Groundwater Seepage Nutrient Loading in a Florida Lake, W86-00065 2H Water Resources on the Pueblo of Laguna, West-Central New Mexico, W86-00108 2F Ground-Water Resources of Audrain County, Missouri, W86-00113 2F Seepage Analysis Using the Boundary Element Method, W86-00228 2G GROUNDWATER POLLUTION One-Dimensional Analytical Solutions for the Migration of a Three-Member Radionuclide Decay Chain in a Multilayered Geologic Medium, W86-00081 5B Potential for Contamination of Shallow Aquifers in Illinois, W86-00178 5E Groundwater Management Strategy for Michigan: Economic and Social Impacts of Groundwater Contamination; A Case Study in East Bay Township, Grand Traverse County, Michigan. W86-00218 5C GROUNDWATER QUALITY Investigation of Waikele Well No. 2401-01, Oahu, Hawaii: Pumping Test, Well Logs and Water Quality, W86-00118 2K GROUNDWATER RESOURCES Stratigraphy and Sedimentary Facies of the Madison Limestone and Associated Rocks in Parts of Montana, Nebraska, North Dakota, South Dakota, Wyoming, W86-0014 2F GROUTING Modification of Bell Canyon Test (BCT) 1-FF Grouting

HOMOGENOUS MEDIA Dispersion in Anisotropic, Homogeneous,	Channel Widths in Bends and Straight Reaches Between Bends for Push Towing: Hydraulic	Computer Modeling of Hydrodynamics and Solute Transport in Canals and Marinas: Litera-
Porous Media, W86-00015 2F	Model Investigation, W86-00225	ture Review and Guidelines for Future Develop- ment,
		W86-00179 5B
HURRICANES Atchafalaya River Delta; Report 8: Numerical	Flood Control Minnesota River, Minnesota, Mankato-North Mankato-LeHillier: Design	HYDROGEN ION CONCENTRATION
Modeling of Hurricane-Induced Storm Surge,	Memorandum No. 8, Part I (Location Study).	Average Rainwater pH, Concepts of Atmos-
W86-00164 2A	W86-00238 8A	pheric Acidity, and Buffering in Open Systems,
HVDB AUT IC DESICN	Mission Bay Harbor, California, Design for	W86-00001 5B
HYDRAULIC DESIGN Storm Sewer Optimum Design,	Wave and Surge Protection and Flood Control:	HYDROGEOLOGY
W86-00100 8B	Hydraulic Model Investigation,	Stratigraphy and Sedimentary Facies of the
HYDRAULIC ENGINEERING	W86-00255 8B	Madison Limestone and Associated Rocks in
Water Surface at Change of Channel Curvature,	Edgewater Marina, Cleveland, Ohio: Design for	Parts of Montana, Nebraska, North Dakota,
W86-00019 8B	Wave Protection, Hydraulic Model Investiga-	South Dakota, Wyoming, W86-00104 2F
HYDRAULIC EQUIPMENT	tion, W86-00256 8B	ROLLING THE THE TOTAL THE
Pointe Coupee Pumping Station Sump and	The state of the s	Analysis and Interpretation of Data Obtained in Tests of the Geothermal Aquifer at Klamath
Outlet Structure, Upper Pointe Coupee Loop	Design for Prevention of Beach Erosion at Presque Isle Beaches, Erie, Pennsylvania: Hy-	Falls, Oregon,
Area, Louisiana: Hydraulic Model Investigation,	draulic Model Investigation,	W86-00107 2F
W86-00101 8C	W86-00257 8B	HVDBOCD A BUC
HYDRAULIC JUMP	List of Soils, Soil-Structure Interaction and	HYDROGRAPHS Attempt to Implement SWMM in Tunisia,
B-Jumps at Abrupt Channel Drops,	Other Related Computer Programs Available	W86-00087 6A
W86-00018 8B	for LMVD Engineers,	
HYDRAULIC MACHINERY	W86-00262 8D	Evaluation of a Hydrograph Shifting Method for Estimating Suspended-Sediment Loads in Il-
Flatiron AGC Interim Controller-Volume IV, W86-00223 8C	Functional Design of Control Structures for	linois Streams,
W 80-00223	Oregon Inlet, North Carolina: Hydraulic Model	W86-00115 2J
HYDRAULIC MODELS	Investigation, W86-00269 8B	HYDROLOGIC DATA
Advancement in Hydraulic Modeling of Porous Pavement Facilities,		Water Resources Data for Florida, Water Year
W86-00098 2E	Barkley Dam Spillway Tainter Gate and Emer- gency Bulkheads, Cumberland River, Kentucky:	1981 Volume 1: Northeast Florida.
	Hydraulic Model Investigation,	W86-00127 7C
Storm Sewer Optimum Design, W86-00100 8B	W86-00284 8C	Water Resources Data for Colorado, Water
reson a legislari con Associa articles ada la car-	Bloomington Spillway North Branch Potomac	Year 1982, Volume 2. Colorado River Basin
Pointe Coupee Pumping Station Sump and Outlet Structure, Upper Pointe Coupee Loop	River Maryland and West Virginia: Hydraulic	above Dolores River,
Area, Louisiana: Hydraulic Model Investigation,	Model Investigation,	W86-00128 7C
W86-00101 8C	W86-00285 8B	Water Resources Data, North Dakota, Water
Digital Simulation of the Regional Effects of	HYDRAULICS	Year 1981, Volume 1. Hudson Bay Basin.
Subsurface Injection of Liquid Waste near Pen-	Hydraulics of a Well Pumped with Linearly	W86-00129 7C
sacola, Florida,	Decreasing Discharge, W86-00040 2F	Water Resources Data Hawaii, Other Pacific
W86-00122 5B	The state of the s	Areas, Water Year 1981. Volume 2. Guam, Northern Mariana Islands, Federated States of
Weir Jetty Performance: Hydraulic and Sedi-	Energy Losses at Straight-Flow-Through Sewer	Micronesia, Palau Islands and American Samoa.
mentary Considerations, Hydraulic Model In-	Junctions, W86-00103 8B	W86-00130 7C
vestigation, W86-00152 8A		HYDROLOGIC DATA COLLECTION
	Hydraulics for Operators, W86-00135 8B	Hydrological Regionalisation: A Question of
Barcelona Harbor, New York, Design for	W100 (2011)	Problem and Scale,
Harbor Improvements: Hydraulic Model Inves- tigation,	Channel Control Structures for Souris River,	W86-00096 2E
W86-00157 8A	Minot, North Dakota: Hydraulic Model Investi- gation,	HYDROLOGIC DATA COLLECTIONS
Buhne Point, Humboldt Bay, California, Design	W86-00209 8A	Hydrological Yearbook: 1980.
for the Prevention of Shoreline Erosion: Hy-	Grays Landing Spillway and Stilling Basin,	W86-00182 2A
draulic and Numerical Model Investigations,	Monongahela River, Pennsylvania: Hydraulic	HYDROLOGIC EVENTS
W86-00169 4D	Model Investigation,	National Water Summary 1983Hydrologic
Navigation Conditions in Vicinity of Walter	W86-00304 8B	Events and Issues.
Bouldin Lock and Dam Coosa River Project:	HYDROCARBONS	W86-00131 6E
Hydraulic Model Investigation,	Hydrocarbons Associated with Suspended	HYDROLOGIC MODELS
W86-00171 8A	Matter in the Green River, Washington, W86-00196 5B	Variogram Identification by the Mean-Squared
HYDRAULIC STRUCTURE		Interpolation Error Method with Application to Hydrologic Fields,
Preventative Measures to Limit Stress Corrosion Cracking in Prestressed Concrete.	Ethylene: Environmental and Technical Infor-	W86-00024 2A
W86-00249 8G	mation for Problem Spills. W86-00303 5C	
HADDWILL CALIFORNIA		Determination of Resistance Parameters of Pluvio-Nivo-Glacial Alpine Systems by Mathe
HYDRAULIC STRUCTURES Technique to Optimally Locate Multilevel In-	HYDRODYNAMICS Hydraulics for Operators,	matical Modeling of Runoff,
takes for Selective Withdrawal Structures,	W86-00135 8B	W86-00034 2E
W86-00213 8A		Attempt to Implement SWMM in Tunisia,
Stream Channel Stability Assessment,	Atchafalaya River Delta; Report 9: Wind Clima- tology,	W86-00087 6A
W86-00214 2J	W86-00163 2L	Parism of Model Use in Francisco Nameiro
MeGee Creek Pumping Station Siphon, Pike	Atchafalaya River Delta; Report 8: Numerical	Review of Model Use in Evaluating Nonpoin Source Loads from Forest Management Activi
County, Illinois: Hydraulic Model Investigation,	Modeling of Hurricane-Induced Storm Surge,	ties,
W86.00219 8B	W86.00164 2A	W86-00091 51

SUBJECT INDEX

HYDROLOGIC MODELS

		TIONG LANG COLEDOTATE
Data Management for Continuous Hydrologic	Evaluation of Hydrologic Processes Affecting	INORGANIC COMPOUNDS
Simulation,	Soil Movement in the Hagerman Fauna Area,	AWWA Survey of Inorganic Contaminants in
W86-00093 2A	Hagerman, Idaho,	Water Supplies.
	W86-00119 2G	W86-00009 5F
Hydrological Regionalisation: A Question of		
Problem and Scale,	ILLINOIS	INTAKES
W86-00096 2E	Evaluation of a Hydrograph Shifting Method	Technique to Optimally Locate Multilevel In-
W 80-00090 2E	for Estimating Suspended-Sediment Loads in Il-	takes for Selective Withdrawal Structures,
Characterization of Aerobic Chemical Processes		
	linois Streams,	W86-00213 8A
in Reservoirs: Problem Description and Model	W86-00115 2J	
Formulation,		INTERCEPTION STORAGE
W86-00176 5B	Runoff, Sediment Transport, and Water Quality	Interception Storage Capacities of Tropical
	in a Northern Illinois Agricultural Watershed	Rainforest Canopy Trees,
Hydrological Simulation ProgramFORTRAN	before Urban Development, 1979-81,	W86-00037 2I
(HSPF): Users Manual for Release 8.0,	W86-00133 2J	11 00-00031
W86-00199 2A		INTERNATIONAL AGREEMENTS
1100-00177	Potential for Contamination of Shallow Aquifers	
TYDROLOGIC TIME SERIES	in Illinois,	Legal, Ethical, Economic and Political Aspects
Effects of Incorrectly Removed Periodicity in	W86-00178 5E	of Transfrontier Pollution,
	1100-00170	W86-00143 6E
Parameters on Stochastic Dependence,	INDIA	Control of the Contro
W86-00075 2A	Monitoring of Reservoir Volume Using Landsat	INTERPOLATIONS
1		Variogram Identification by the Mean-Squared
TYDROLOGY	Data,	Interpolation Error Method with Application to
European and United States Case Studies in	W86-00032 7C	Hydrologic Fields,
Application of the CREAMS Model.		
W86-00294 5B	Estimates of Peak Runoff from Hilly Terrain	W86-00024 2A
	with Varied Lithology,	IDEL AND
CREAMS: A System for Evaluating Manage-	W86-00036 2E	IRELAND
ment Practices on Field-Size Areas,		Heterotrophic Slimes in Irish Rivers, Evaluation
The state of the s	INDUSTRIAL WASTES	of the Problem,
W86-00295 5B	Deposit Control Technology for Kraft Recov-	W86-00053 5B
Testing the Application of CDE AMS to Finally	ery Units,	
Testing the Application of CREAMS to Finnish	W86-00170 5D	IRRIGATION
Conditions,	W 80-00170	Agricultural Water Demands,
W86-00296 5B	Oil Shale Mining, Processing, Uses, and Envi-	W86-00274 6D
		W 80-002/4
Environmental Effects of Nitrogen Fertilization	ronmental Impacts, 1978-July, 1981: Citations	IDDICATION DDACTICES
Exemplified by Groundwater Pollution as Simu-	from the NTIS Data Base.	IRRIGATION PRACTICES
lated by CREAMS,	W86-00201 4C	Sediment Transport by Irrigation Return Flows
W86-00297 5B		in Four Small Drains Within the DID-18 Drain-
11 00 00271	Development Document for Effluent Limita-	age of the Sulphur Creek Basin, Yakima County,
Application of the CREAMS Model for Calcu-	tions Guidelines and Standards for the Textile	Washington, April 1979 to October 1981,
lation of Leaching of Nitrate from Light Soils in	Mills Point Source Category.	W86-00112 2J
the Notec River Valley,	W86-00207 5G	
		IRRIGATION RETURN FLOW
W86-00298 5B	Survey of National and State Regulatory	Investigation of Waikele Well No. 2401-01,
	Agency Policy and Procedures for the Determi-	
Application of the CREAMS Model: Western	nation of the Toxicity of Wastewater Effluents.	Oahu, Hawaii: Pumping Test, Well Logs and
Skane, Sweden,	W86-00211 6E	Water Quality,
W86-00299 5B	W 80-00211 0E	W86-00118 2K
	Oil Shale Mining, Processing, Uses, and Envi-	
Predicting Hillslope Runoff and Erosion in the	ronmental Impacts, August, 1981-October, 1982:	ITALY
United Kingdom: Preliminary Trials with the	Citations from the NTIS Data Base.	Analysis of the Effects of Orography on Surface
CREAMS Model,		Rainfall by a Parameterized Numerical Model,
W86-00300 5B	W86-00215 5D	W86-00023 2B
		W 00 00025
Application of the CREAMS Model as Part of	INDUSTRIAL WASTEWATER	Determination of Resistance Parameters of
an Overall System for Optimizing Environmen-	Computer Simulation of an Industrial	Pluvio-Nivo-Glacial Alpine Systems by Mathe-
tal Management in Lithuania, USSR: First Ex-	Wastewater Treatment Process,	matical Modeling of Runoff,
periments,	W86-00058 5D	
		W86-00034 2E
W86-00301 5B	Survey of Polychlorinated Biphenyls in Industri-	Total and the Park D. M. C. Strip
	al Effluents in Canada.	Estimates of Peak Runoff from Hilly Terrain
Review of Case Studies of CREAMS Model	W86-00286 5B	with Varied Lithology,
Application,	7. 5.7-502.50 7. 5.7-502.50	W86-00036 2E
W86-00302 5B	INDUSTRIAL WATER	
		IVERTEBRATES
HYPOLIMNETIC AERATION	Industrial Water Demands,	Aquatic Habitat Studies on the Lower Mississip-
Hypolimnetic Aeration: Practical Design and	W86-00273 6D	pi River: River Mile 480-530; Report 3: Benthic
Application,		Macroinvertebrate Studies Pilot Report,
W86-00060 5G	INFILTRATION	
1100-4000	Infiltration Under Ponded Conditions: 1. Opti-	W86-00212 6G
TCP		
ICE	mal Analytical Solution and Comparison with	TADAN
		JAPAN
Ground-Base Snow and Ice Crystal Observation	mal Analytical Solution and Comparison with	Field Observations and Numerical Experiments
System Used in Sierra Nevada Winter Orogra-	mal Analytical Solution and Comparison with Experimental Observations,	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called
System Used in Sierra Nevada Winter Orogra- phic Storms,	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G	Field Observations and Numerical Experiments
System Used in Sierra Nevada Winter Orogra-	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called
System Used in Sierra Nevada Winter Orogra- phic Storms,	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil,	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam,
System Used in Sierra Nevada Winter Orogra- phic Storms,	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam,
System Used in Sierra Nevada Winter Orographic Storms, W86-00222 2B ICE FORMATION	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil, W86-00078 2G	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam, W86-00038 2F Regional Unsteady Interface Between Fresh
System Used in Sierra Nevada Winter Orographic Storms, W86-00222 2B ICE FORMATION SCPP Data Collection and Analysis for the	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil, W86-00078 2G Seepage Analysis Using the Boundary Element	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam, W86-00038 2F Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal
System Used in Sierra Nevada Winter Orographic Storms, W86-00222 2B ICE FORMATION SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil, W86-00078 2G Seepage Analysis Using the Boundary Element Method,	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam, W86-00038 2F Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal Aquifer,
System Used in Sierra Nevada Winter Orographic Storms, W86-00222 2B ICE FORMATION SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August 1982,	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil, W86-00078 2G Seepage Analysis Using the Boundary Element	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam, W86-00038 2F Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal
System Used in Sierra Nevada Winter Orographic Storms, W86-00222 2B ICE FORMATION SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil, W86-00078 2G Seepage Analysis Using the Boundary Element Method, W86-00228 2G	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam, W86-00038 2F Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal Aquifer, W86-00042 2F
System Used in Sierra Nevada Winter Orographic Storms, W86-00222 2B ICE FORMATION SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August 1982, W86-00216 2B	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil, W86-00078 2G Seepage Analysis Using the Boundary Element Method, W86-00228 2G INJECTION	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam, W86-00038 2F Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal Aquifer, W86-00042 2F JETTIES
System Used in Sierra Nevada Winter Orographic Storms, W86-00222 2B ICE FORMATION SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August 1982, W86-00216 2B IDAHO	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil, W86-00078 2G Seepage Analysis Using the Boundary Element Method, W86-00228 2G INJECTION Digital Simulation of the Regional Effects of	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam, W86-00038 2F Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal Aquifer, W86-00042 2F JETTIES Weir Jetty Performance: Hydraulic and Sedi-
System Used in Sierra Nevada Winter Orographic Storms, W86-00222 2B ICE FORMATION SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August 1982, W86-00216 2B IDAHO Ground-Water Conditions in the Cottonwood-	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil, W86-00078 2G Seepage Analysis Using the Boundary Element Method, W86-00228 2G INJECTION Digital Simulation of the Regional Effects of Subsurface Injection of Liquid Waste near Pen-	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam, W86-00038 Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal Aquifer, W86-00042 JETTIES Weir Jetty Performance: Hydraulic and Sedimentary Considerations, Hydraulic Model In-
System Used in Sierra Nevada Winter Orographic Storms, W86-00222 2B ICE FORMATION SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August 1982, W86-00216 2B IDAHO	mal Analytical Solution and Comparison with Experimental Observations, W86-00049 2G Numerical Calculation of Saturated-Unsaturated Infiltration in a Cracked Soil, W86-00078 2G Seepage Analysis Using the Boundary Element Method, W86-00228 2G INJECTION Digital Simulation of the Regional Effects of	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called Kanto Loam, W86-00038 2F Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal Aquifer, W86-00042 2F JETTIES

8A

KANSAS	Plants: Selected Life History Information of	LEGIONELLA
Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and	Animal Species on Lake Conway, FL, W86-00197 4A	Wastewater Reuse and Exposure to Legionella Organisms,
Adjacent Areas, W86-00121 5A	Volunteer Lake Monitoring, 1981,	W86-00054 5C
Natural Ground-Water-Recharge Data from	W86-00200 5C	LIMITING NUTRIENTS
Three Selected Sites in Harvey County, South- Central Kansas,	Large-Scale Operations Management Test of Use of the White Amur for Control of Problem	Unified Theory for Microbial Growth under Multiple Nutrient Limitation, W86-00067 2H
W86-00132 2F	Aquatic Plants: The Herpetofauna of Lake Conway, Species Accounts,	LIMNOLOGY
KANTO LOAM Field Observations and Numerical Experiments	W86-00202 6G	Volunteer Lake Monitoring, 1981,
on a Drying Front in a Volcanic Ash Soil Called	Effects of Beach Nourishment on the Nearshore	W86-00200 5C
Kanto Loam, W86-00038 2F	Environment in Lake Huron at Lexington Harbor (Michigan),	LINEAR CASCADES Discrete-Time Linear Cascade under Time
KENTUCKY	W86-00224 6G	Averaging, W86-00028 2A
Spatially Varying Rainfall and Floodrisk Analy-	Lakes and Microcosms: Extending Microcosm Data to Aquatic Ecosystems,	W86-00028 2A LINEAR PROGRAMMING
8is, W86-00012 2E	W86-00231 5C	Optimal Urban Water Distribution Design,
KIKI RIVER ESTUARY	Optimum Microcosms for Lake Ecotoxicology,	W86-00071 SF
Regional Unsteady Interface Between Fresh	W86-00232 5C	LIQUID WASTES
Water and Salt Water in a Confined Coastal Aquifer,	Edgewater Marina, Cleveland, Ohio: Design for Wave Protection, Hydraulic Model Investiga-	Digital Simulation of the Regional Effects of Subsurface Injection of Liquid Waste near Pen-
W86-00042 2F	tion,	sacola, Florida, W86-00122 5B
KRAFT MILLS Deposit Control Technology for Kraft Recov-	W86-00256 8B	LITERATURE REVIEW
ery Units, W86-00170 5D	Design for Prevention of Beach Erosion at Presque Isle Beaches, Erie, Pennsylvania: Hy-	Microbiological Water Quality of Impound- ments: A Literature Review,
STATE OF THE STATE	draulic Model Investigation, W86-00257 8B	W86-00185 SA
LAGOONS Ponds and Lagoons of Horn and Petit Bois		LITERATURE REVIEWS
Islands, Mississippi, Gulf Islands National Sea-	Locations and Areas of Ponds and Carolina Bays at the Savannah River Plant,	Recovery and Restoration of Rocky Shores,
shore: Their Physical Size, Literature Review and Recommendations for Future Research,	W86-00263 2H	Sandy Beaches, Tidal Flats, and Shallow Subti- dal Bottoms Impacted by Oil Spills,
W86-00278 2H	Wave Data Acquisition and Hindcast for Sagi-	W86-00240 5C
LAGRANGIAN CIRCULATION Effects of Spatial Variation in Amplitude and	naw Bay, Michigan, W86-00282 2H	Recovery and Restoration of Salt Marshes and Mangroves Following an Oil Spill,
Phase of the Oscillatory Tidal Currents on the	LAND DEVELOPMENT	W86-00242 5C
Residual Lagrangian Drifts, W86-00085 2L	Planning and Implementation of Regional Stormwater Management Facilities in Montgom-	LITHOLOGY Estimates of Peak Runoff from Hilly Terrain
LAKE	ery County, Maryland,	with Varied Lithology,
Phytoplankton-Environmental Interactions in Reservoirs, Volume II: Discussion of Workshop	W86-00099 4A	W86-00036 2E
Papers and Open Literature,	LAND TREATMENT Toxic Organics Removal Kinetics in Overland	LITTORAL ENVIRONMENTS
W86-00206 2H	Flow Land Treatment,	Recovery and Restoration of Rocky Shores, Sandy Beaches, Tidal Flats, and Shallow Subti-
LAKE CONSTANCE Seasonal Succession of Phytoplankton in Lake	W86-00057 5D	dal Bottoms Impacted by Oil Spills, W86-00240 5C
Constance,	LAND USE	
W86-00051 2H	Preliminary Evaluation of Lake Susceptibility to Water-Quality Degradation by Recreational	Navigation Conditions in Vicinity of Walter
LAKE ERIE Long-Term Impact of Dredged Material at Two	Use, Alpine Lakes Wilderness Area, Washington,	Bouldin Lock and Dam Coosa River Project: Hydraulic Model Investigation,
Open-Water Sites: Lake Erie and Elliot Bay; Evaluative Summary,	W86-00114 5C	W86-00171 8A
W86-00160 5C	Effects of Acid Rain on Soil and Water, W86-00166 2K	Navigation Conditions at Mitchell Lock and
LAKE RESTORATION		Dam, Coosa River, Alabama, W86-00177 8A
Hypolimnetic Aeration: Practical Design and	LANDFILLS Leachate from Hazardous Wastes Sites.	Development of a Numerical Modeling Capabil-
Application, W86-00060 5G	W86-00247 5B	ity for the Computation of Unsteady Flow on the Ohio River and Its Major Tributaries,
Flow Balancing Method for Stormwater and	LANDSAT Monitoring of Reservoir Volume Using Landsat	W86-00220 2E
Combined Sewer Overflow. W86-00191 5D	Data,	LOG PEARSON TYPE-3 DISTRIBUTION
	W86-00032 7C	Variance of the T-year Event in the Log Pear-
LAKE WASHINGTON Historical Changes to Lake Washington and	LEACHATES	son Type-3 Distribution, W86-00031 2E
Route of the Lake Washington Ship Canal, King County, Washington,	Leachate from Hazardous Wastes Sites, W86-00247 5B	MADISON LIMESTONE
W86-00105 2H	LEAD	Stratigraphy and Sedimentary Facies of the Madison Limestone and Associated Rocks in
LAKES	Heavy Metal Accumulation (Cd, Cu, Pb and	Parts of Montana, Nebraska, North Dakota,
User Guide for LARM2: A Longitudinal-Verti-	Zn) by Smelt (Osmerus mordax) From the North Shore of the St Lawrence Estuary (Accu-	South Dakota, Wyoming, W86-00104 2F
cal, Time-Varying Hydrodynamic Reservoir Model,	mulation de Quelques Metaux Lourds (Cd, Cu,	
W86-00190 5B	Pb Et Zn) Chez L'Eperlan (Osmerus mordax) Preleve Sur La Rive Nord De L'Estuaire du	MAMMOTH LAKES Water-Ouality Appraisal, Mammoth Creek and
Large-Scale Operations Management Test of	Saint-Laurent),	Hot Creek, Mono County, California,
Use of the White Amur for Control of Problem	W86-00059 5C	W86-00106 5A

MANGROVE SWAMPS

MANGROVE SWAMPS	User's Guide for a Plane and Axisymmetric	MATHEMETICAL MODELS
Recovery and Restoration of Salt Marshes and Mangroves Following an Oil Spill,	Finite Element Program for Steady-State Seep- age Problems,	Atchafalaya River Delta; Report 8: Numerical Modeling of Hurricane-Induced Storm Surge,
W86-00242 5C	W86-00156 2G	W86-00164 Storm Surge,
MANHOLES Energy Losses at Straight-Flow-Through Sewer	Preliminary User's Manual 3-D Mathematical Model of Coastal, Estuarine, and Lake Currents	MEAN SQUARED INTERPOLATION ERROR METHOD
Junctions, W86-00103 8B	(CELC3D), W86-00168 2E	Variogram Identification by the Mean-Squared Interpolation Error Method with Application to
MAPS		Hydrologic Fields,
Hydrogeologic and Water-Quality Characteris-	Characterization of Aerobic Chemical Processes	W86-00024 2A
tics of the Mount Simon-Hinckley Aquifer,	in Reservoirs: Problem Description and Model Formulation,	A Committee of the Comm
Southeast Minnesota, W86-00109 2K	W86-00176 5B	MEAT PROCESSING INDUSTRY Evaluation of the 'Lectro Clear Z' Electrocoa-
Water Table in Rocks of Cenozoic and Paleozo-	Seepage Analysis Using the Boundary Element	gulation Process for Meat Packing Wastewater
ic Age, 1980, Yucca Flat, Nevada Test Site, Nevada,	Method, W86-00228 2G	Treatment. W86-00252 5D
W86-00116 2F		MELTING
	European and United States Case Studies in Application of the CREAMS Model.	Snowmelt Induced Urban Runoff in Northern
MARINAS Computer Modeling of Hydrodynamics and	W86-00294 5B	Sweden,
Solute Transport in Canals and Marinas: Litera-	W 80-00254	W86-00097 2C
ture Review and Guidelines for Future Develop-	CREAMS: A System for Evaluating Manage-	The state of the s
ment,	ment Practices on Field-Size Areas,	METEOROLOGIC DATA COLLECTION
W86-00179 5B	W86-00295 5B	Boulder Upslope Cloud Observation Experi-
MARINE CLIMATES Marine Weather of the Inland Waters of West-	Testing the Application of CREAMS to Finnish Conditions,	ment. W86-00261 2B
ern Washington,	W86-00296 5B	METEOROLOGICAL DATA COLLECTIONS
W86-00165 2B	W 80-00290	STREX TOVS/Radiosonde Comparison, Part I:
	Environmental Effects of Nitrogen Fertilization	TOVS/AVHRR and Radiosonde Inventory,
MARINE ENVIRONMENT	Exemplified by Groundwater Pollution as Simu-	W86-00187 7B
Results of an Adaptive Environmental Assess-	lated by CREAMS,	1100 00101
ment Modeling Workshop- Concerning Poten- tial Impacts of Drilling Muds and Cuttings on	W86-00297 5B	METEOROLOGY
the Marine Environment,	Application of the CREAMS Model for Calcu-	Marine Weather of the Inland Waters of West-
W86-00147 5C	lation of Leaching of Nitrate from Light Soils in the Notec River Valley,	ern Washington, W86-00165 2B
MARINE FISHERIES	W86-00298 5B	
Fisheries Resource Impacts from Spills of Oil or Hazardous Substances.	Land of the second of the seco	METHANE Dissolved Methane Concentrations in the South-
W86-00244 5C	Application of the CREAMS Model: Western	east Bering Sea, 1980 and 1981,
	Skane, Sweden, W86-00299 5B	W86-00180 2K
MARKER BEDS Stratigraphy and Sedimentary Facies of the	W 80-00277 JB	
Madison Limestone and Associated Rocks in Parts of Montana, Nebraska, North Dakota,	Predicting Hillslope Runoff and Erosion in the United Kingdom: Preliminary Trials with the	MICROBIAL GROWTH MODELS Unified Theory for Microbial Growth under
South Dakota, Wyoming,	CREAMS Model,	Multiple Nutrient Limitation,
W86-00104 2F	W86-00300 5B	W86-00067 2H
MARKE BUILD	Application of the CREAMS Model as Part of	MICROBIOLOGIAL STUDIES
MARNE RIVER Rapidity of RNA Synthesis in Human Cells; A	an Overall System for Optimizing Environmen-	Microbiological Water Quality of Impound-
Highly Sensitive Parameter for Water Cytotoxi-	tal Management in Lithuania, USSR: First Ex-	ments: A Literature Review,
city Evaluation,	periments,	W86-00185 5A
W86-00052 5A	W86-00301 5B	and the second s
MARSHES	Benjam of Case Studies of CREAMS Model	MICROBIOLOGICAL STUDIES
Shore Stabilization with Salt Marsh Vegetation,	Review of Case Studies of CREAMS Model Application,	Monitoring Marine Microbial Fouling.
W86-00189 8G	W86-00302 5B	W86-00227 5A
		MICROCOSMS
Recovery and Restoration of Salt Marshes and	MATHEMATICAL STUDIES	Lakes and Microcosms: Extending Microcosm
Mangroves Following an Oil Spill, W86-00242 5C	Transport of Suspended Material in Open and	Data to Aquatic Ecosystems,
	Submerged Streams, W86-00013	W86-00231 5C
MATHEMATICAL EQUATIONS	W86-00013 2J	
Infiltration Under Ponded Conditions: 1. Opti- mal Analytical Solution and Comparison with	Statistical Choice of Extremal Models for Com- plete and Censored Data,	Optimum Microcosms for Lake Ecotoxicology, W86-00232 5C
Experimental Observations,	W86-00026 2A	Clause of Pastonical saint Tests. Their Advan
W86-00049 2G	THE REPORT OF THE PARTY OF THE	Classes of Ecotoxicological Tests: Their Advan- tages and Disadvantages for Regulation,
MATHEMATICAL MODELS	Analytical Solutions for Periodic Well Recharge	W86-00236 5C
Numerical Modelling of Subcritical Open Chan-	in Rectangular Aquifers with Third-Kind	1100 00230
nel Flow Using the K-epsilon Turbulence Model	Boundary Conditions, W86-00041 2F	MICROENVIRONMENT
and the Penalty Function Finite Element Tech-	W00-000+1 2F	Lakes and Microcosms: Extending Microcosm
nique, W86-00003 2E	Mixing Zone Model for Conservative Param-	Data to Aquatic Ecosystems, W86-00231 5C
Determination of Besisters Bernard	eters,	
Determination of Resistance Parameters of Pluvio-Nivo-Glacial Alpine Systems by Mathe-	W86-00089 5G	MICRONESIA
matical Modeling of Runoff,	Estimation of Missing Values in Monthly Rain-	Rainwater Catchment Water Quality in Micro-
W86-00034 2E	fall Series,	nesia,
	W86-00094 2B	W86-00061 3E
SEDMNT: A Sediment Transport Submodel Based on Hydrodynamic Principles for the Uni-	Areal Intensity-Duration-Frequency Curves: A	MICROORGANISMS
fied Transport Model,	Possible Way of Improving the Rainfall Input,	Monitoring Marine Microbial Fouling.
W86-00155 2J	W86-00095 2B	W86-00227 5A

MINE DRAINAGE	Application of the STORM Model to Design	Modeling Water Demands.
Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and	Problems in Singapore and in Kaosiung, Repub- lic of China,	W86-00270 6D
Adjacent Areas,	W86-00086 6A	Water Demand,
W86-00121 5A		W86-00271 6D
MINE WASTES	Attempt to Implement SWMM in Tunisia,	LTI UW
MINE WASTES Oil Shale Mining, Processing, Uses, and Envi-	W86-00087 6A	Methodological Framework,
ronmental Impacts, 1978-July, 1981: Citations	Sediment-Water Interface in Modeling Pesti-	W86-00272 6D
from the NTIS Data Base.	cides in Sedimentation Ponds.	Industrial Water Daniel
W86-00201 4C	W86-00088 5B	Industrial Water Demands, W86-00273 6D
W 80-00201 4C		W86-00273 6D
Oil Shale Mining, Processing, Uses, and Envi-	Mixing Zone Model for Conservative Param-	Agricultural Water Demands,
ronmental Impacts, August, 1981-October, 1982:	eters,	W86-00274 6D
Citations from the NTIS Data Base.	W86-00089 5G	110000214
W86-00215 5D	Some Recent Adaptations and Applications of	Municipal Water Demands,
Long-Term Ecological Behaviour of Aban-	QUAL-II in the Northeast,	W86-00275 6D
doned Uranium Mill Tailings; 2.: Growth Pat-	W86-00090 5B	tally managed and a second
terns of Indigenous Vegetation on Terrestrial		Programming Models for Regional Water
and Semi-Aquatic Areas,	Review of Model Use in Evaluating Nonpoint	Demand Analysis,
W86-00217 5C	Source Loads from Forest Management Activi-	W86-00276 6D
emWindows I are a set a	ties,	National Perspective in Water Demand Model-
MINERALIZATION	W86-00091 5B	ing,
Water-Quality Appraisal, Mammoth Creek and	Mechanistic Simulation for Transport of Non-	W86-00277 6D
Hot Creek, Mono County, California, W86-00106 5A	point Source Pollutants,	1/10/11/11
W 60-00100	W86-00092 5B	Bloomington Spillway North Branch Potomac
MISSISSIPPI RIVER		River Maryland and West Virginia: Hydraulic
Removal by Coagulation of Trace Organics	Data Management for Continuous Hydrologic	Model Investigation,
from Mississippi River Water,	Simulation,	W86-00285 8B
W86-00011 5F	W86-00093 2A	ANSWERS (Areal Nonpoint Source Watershed
MOCOURT	Estimation of Missing Values in Monthly Rain-	Environment Response Simulation) User's
MISSOURI	fall Series,	Manual.
Ground-Water Resources of Audrain County, Missouri.	W86-00094 2B	W86-00287 4D
W86-00113 2F		W 30-00207
	Planning and Implementation of Regional	European and United States Case Studies in
MIXED LIQUOR SOLIDS	Stormwater Management Facilities in Montgom-	Application of the CREAMS Model.
New Concepts and Practices in Activated	ery County, Maryland, W86-00099 4A	W86-00294 5B
Sludge Process Control,	W86-00099 4A	CDT-116 1 C
W86-00221 5D	Pointe Coupee Pumping Station Sump and	CREAMS: A System for Evaluating Manage-
MIXING	Outlet Structure, Upper Pointe Coupee Loop	ment Practices on Field-Size Areas, W86-00295 5B
Mixing Zone Model for Conservative Param-	Area, Louisiana: Hydraulic Model Investigation,	W 80-00293
eters,	W86-00101 8C	Testing the Application of CREAMS to Finnish
W86-00089 5G	Dimensions for Safe and Efficient Deep Dunk	Conditions,
MODEL CHINES	Dimensions for Safe and Efficient Deep-Draft Navigation Channels: Hydraulic Model Investi-	W86-00296 5E
MODEL STUDIES	gation,	land to the same and the same of
Nonlinear Time-Variant Constrained Model for Rainfall-Runoff,	W86-00148 8B	Environmental Effects of Nitrogen Fertilization
W86-00022 2A		Exemplified by Groundwater Pollution as Simu-
W 80-00022	Buhne Point, Humboldt Bay, California, Design	lated by CREAMS,
Analysis of the Effects of Orography on Surface	for the Prevention of Shoreline Erosion: Hy-	W86-00297 5E
Rainfall by a Parameterized Numerical Model,	draulic and Numerical Model Investigations,	Application of the CREAMS Model for Calcu-
W86-00023 2B	W86-00169 4D	lation of Leaching of Nitrate from Light Soils in
Discrete-Time Linear Cascade under Time	Navigation Conditions in Vicinity of Walter	the Notec River Valley,
Averaging,	Bouldin Lock and Dam Coosa River Project:	W86-00298 5B
W86-00028 2A	Hydraulic Model Investigation,	
	W86-00171 8A	Application of the CREAMS Model: Western
Comparison of Two Daily Streamflow Simula-	Navigation Conditions at Mitchell Lock and	Skane, Sweden, W86-00299 5B
tion Models of an Alpine Watershed,	Navigation Conditions at Mitchell Lock and Dam, Coosa River, Alabama,	W86-00299 5E
W86-00033 2E	W86-00177 8A	Predicting Hillslope Runoff and Erosion in the
Regional Unsteady Interface Between Fresh		United Kingdom: Preliminary Trials with the
Water and Salt Water in a Confined Coastal	Foundations of Principal Component Selection	CREAMS Model,
Aquifer,	Rules,	W86-00300 5E
W86-00042 2F	W86-00186 7C	
Two Alassishma Per Burnatus Posturatus In	User Guide for LARM2: A Longitudinal-Verti-	Application of the CREAMS Model as Part of
Two Algorithms For Parameter Estimation in Groundwater Flow Problems,	cal, Time-Varying Hydrodynamic Reservoir	an Overall System for Optimizing Environmen- tal Management in Lithuania, USSR: First Ex-
W86-00044 2F	Model,	
11 55-00011	W86-00190 5B	periments, W86-00301 5E
Comparing the Performance of Root-Water-		11 000001
Uptake Models,	Hydrological Simulation Program-FORTRAN	Review of Case Studies of CREAMS Mode
W86-00048 2D	(HSPF): Users Manual for Release 8.0,	Application,
Unified Theory for Microbial Growth under	W86-00199 2A	W86-00302 5I
Multiple Nutrient Limitation,	Modeling of an ANFLOW Municipal Waste-	MODEL SECTION
W86-00067 2H	Treatment Unit,	MODEL TESTING
	W86-00246 5D	Estimation of Missing Values in Monthly Rain
Dynamic Model for Multireservoir Operation,	Mathematical Model CER ATRA Co-Collins	fall Series, W86-00094 21
W86-00069 6A	Mathematical Model, SERATRA, for Sediment-	W86-00094 21
Quadratic Model for Reservoir Management:	Contaminant Transport in Rivers and Its Appli- cation to Pesticide Transport in Four Mile and	MODELS
Application to the Central Valley Project,	Wolf Creeks in Iowa.	Storm Sewer Optimum Design,
Wee coord	W96 00050 SB	W86,00100 81

MODELS

Pointe Coupee Pumping Station Sump and Outlet Structure, Upper Pointe Coupee Loop	NETWORK DESIGN SCPP Data Collection and Analysis for the	Predicting Hillslope Runoff and Erosion in the United Kingdom: Preliminary Trials with the
Area, Louisiana: Hydraulic Model Investigation,	Period 1 September 1981 through 31 August 1982,	CREAMS Model, W86-00300 5B
	W86-00216 2B	
MONITORING		Application of the CREAMS Model as Part of
Volunteer Lake Monitoring, 1981, W86-00200 5C	NEVADA Water Table in Rocks of Cenozoic and Paleozo-	an Overall System for Optimizing Environmen- tal Management in Lithuania, USSR: First Ex-
1100 00200	ic Age, 1980, Yucca Flat, Nevada Test Site,	periments,
New Concepts and Practices in Activated	Nevada,	W86-00301 5B
Sludge Process Control, W86-00221 5D	W86-00116 2F	Review of Case Studies of CREAMS Model
	NEW JERSEY	Application,
Addendum to Handbook for Sampling and Sample Preservation.	Flood Damage Alleviation in New Jersey,	W86-00302 5B
W86-00268 5A	W86-00173 6F	NORMATIVE ECONOMICS
	Present and Prospective Use of Water by the	NORMATIVE ECONOMICS Normative Economics and the Acid Rain Prob-
MOUNTAINS Runoff from Glacierized Mountains: A Model	Manufacturing Industries of New Jersey,	lem,
for Annual Variation and Its Forecasting,	W86-00175 6D	W86-00141 6B
W86-00077 2E	NEW MEXICO	NORTH DAKOTA
MULCHES	Water Resources on the Pueblo of Laguna,	Water Resources Data, North Dakota, Water
Soil Water Evaporation Suppression by Sand	West-Central New Mexico, W86-00108 2F	Year 1981, Volume 1. Hudson Bay Basin.
Mulches,	W 80-00108 2F	W86-00129 7C
W86-00050 2G	NITROGEN	NUMERICAL ANALYSIS
MUNICIPAL WATER	Nitrogen and Phosphorus Speciation and Flux in a Large Florida River Wetland System,	Field Observations and Numerical Experiments
Public Water Supplies in Gloucester County,	W86-00080 2H	on a Drying Front in a Volcanic Ash Soil Called
N.J., W86-00174 2F		Kanto Loam,
	Some Recent Adaptations and Applications of QUAL-II in the Northeast,	W86-00038 2F
Modeling Water Demands. W86-00270 6D	W86-00090 5B	Mixing Zone Model for Conservative Param-
W80-002/0		eters,
Municipal Water Demands,	NONLINEAR MODELS Nonlinear Time-Variant Constrained Model for	W86-00089 5G
W86-00275 6D	Rainfall-Runoff,	NUTRIENT LOADING
National Perspective in Water Demand Model-	W86-00022 2A	Groundwater Seepage Nutrient Loading in a
ing, W86-00277 6D	NONPOINT POLLUTION SOURCES	Florida Lake,
W86-002//	Review of Model Use in Evaluating Nonpoint	W86-00065 2H
NAEGLERIA	Source Loads from Forest Management Activi-	NUTRIENTS
Inactivation of Naegleria gruberi Cysts by Chlo- rine Dioxide,	ties,	Some Recent Adaptations and Applications of
W86-00066 5F	W86-00091 5B	QUAL-II in the Northeast,
	Mechanistic Simulation for Transport of Non-	W86-00090 5B
NAKA RIVER ESTUARY Regional Unsteady Interface Between Fresh	point Source Pollutants, W86-00092 5B	Nutrient Input from the Loxahatchee River En-
Water and Salt Water in a Confined Coastal	W80-00092 3B	vironmental Control District Sewage-Treatment
Aquifer,	Point Sources-Nonpoint Sources Trading in the	Plant to the Loxahatchee River Estuary, South- eastern Florida,
W86-00042 2F	Lake Dillon Watershed. W86-00167 5B	W86-00110 5B
NATIONAL WATER ASSESSMENT		NUE COUNTY
National Water Summary 1983Hydrologic	Planning Guide for Evaluating Agricultural	NYE COUNTY Water Table in Rocks of Cenozoic and Paleozo-
Events and Issues. W86-00131 6B	Nonpoint Source Water Quality Controls, W86-00260 5G	ic Age, 1980, Yucca Flat, Nevada Test Site,
		Nevada,
NAVIGATION Dimensions for Safe and Efficient Deep-Draft	ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) User's	W86-00116 2F
Navigation Channels: Hydraulic Model Investi-	Manual.	OIL POLLUTION
gation,	W86-00287 4D	Restoration of Habitats Impacted by Oil Spills.
W86-00148 8B	European and United States Case Studies in	W86-00239 5C
Navigation Conditions in Vicinity of Walter		Recovery and Restoration of Rocky Shores,
Bouldin Lock and Dam Coosa River Project:	W86-00294 5B	Sandy Beaches, Tidal Flats, and Shallow Subti-
Hydraulic Model Investigation, W86-00171 8A	CREAMS: A System for Evaluating Manage-	dal Bottoms Impacted by Oil Spills,
	ment Practices on Field-Size Areas,	W86-00240 5C
Navigation Conditions at Mitchell Lock and	W86-00295 5B	Effects of Oil on Seagrass Ecosystems,
Dam, Coosa River, Alabama, W86-00177 8A	Testing the Application of CREAMS to Finnish	W86-00241 5C
	Conditions,	Recovery and Restoration of Salt Marshes and
Cleveland Harbor, Ohio: Design for the Safe and Efficient Passage of 1,000-ft-Long Vessels at		Mangroves Following an Oil Spill,
the West (Main) Entrance, Hydraulic Model In-		W86-00242 5C
vestigation,	Exemplified by Groundwater Pollution as Simu-	Measurements of Damage, Recovery, and Reha-
W86-00204 8A		bilitation of Coral Reefs Exposed to Oil,
Development of a Numerical Modeling Capabil-	W86-00297 5B	W86-00243 5C
ity for the Computation of Unsteady Flow or	Application of the CREAMS Model for Calcu-	Fisheries Resource Impacts from Spills of Oil or
the Ohio River and Its Major Tributaries, W86-00220 2E	lation of Leaching of Nitrate from Light Soils in the Notec River Valley,	Hazardous Substances,
	W86-00298 5B	W86-00244 5C
NEBRASKA		OIL RECOVERY
Time-of-Travel Data for Nebraska Streams 1968 to 1977,	 Application of the CREAMS Model: Western Skane, Sweden, 	Winter Evaluation of Oil Skimmers and Booms.
W86-00120 2E		W86-00290 5G

2E

OIL SHALE Oil Shale Mining, Processing, Uses, and Envi-	Toxic Organics Removal Kinetics in Overland Flow Land Treatment,	Decay Chain in a Multilayered Geologic Medium,
ronmental Impacts, 1978-July, 1981: Citations from the NTIS Data Base.	W86-00057 5D	W86-00081 5B
W86-00201 4C	Laboratory Protocols for Evaluating the Fate of Organic Chemicals in Air and Water,	Mechanistic Simulation for Transport of Non- point Source Pollutants,
Oil Shale Mining, Processing, Uses, and Envi- ronmental Impacts, August, 1981-October, 1982:	W86-00154 5A	W86-00092 5B
Citations from the NTIS Data Base. W86-00215 5D	Ecotoxicology at the Watershed Level, W86-00234 5B	Arctic Marine Oilspill Program (AMOP) Remote Sensing Study,
OIL SLICKS	Survey of Polychlorinated Biphenyls in Industri-	W86-00258 7B
Fate of Chemically Dispersed Oil in the Sea: A Report on Two Field Experiments, W86-00172 5B	al Effluents in Canada. W86-00286 5B	PAVING Advancement in Hydraulic Modeling of Porous
	Effects, Pathways, Processes, and Transforma-	Pavement Facilities, W86-00098 2E
OIL SPILLS Restoration of Habitats Impacted by Oil Spills. W86-00239 5C	tion of Puget Sound Contaminants of Concern, W86-00293 5B	PEAK DISCHARGE (WATER)
	ORGANOCHLORINE PESTICIDES	Runoff, Sediment Transport, and Water Quality
Recovery and Restoration of Rocky Shores, Sandy Beaches, Tidal Flats, and Shallow Subti- dal Bottoms Impacted by Oil Spills,	Ecosystem Approach to the Toxicology of Resi- due Forming Xenobiotic Organic Substances in the Great Lakes,	in a Northern Illinois Agricultural Watershed before Urban Development, 1979-81, W86-00133 2J
W86-00240 5C	W86-00237 5B	PEAK FLOWS
Effects of Oil on Seagrass Ecosystems,	OROGRAPHY	Method of Predicting Daily Peak Flows in the
W86-00241 5C	Analysis of the Effects of Orography on Surface	High-Flow Season,
Recovery and Restoration of Salt Marshes and	Rainfall by a Parameterized Numerical Model,	W86-00027 2E
Mangroves Following an Oil Spill,	W86-00023 2B	PEAK RUNOFF
W86-00242 5C	OUTFALL TUNNELS	Estimates of Peak Runoff from Hilly Terrain
Measurements of Damage, Recovery, and Reha- bilitation of Coral Reefs Exposed to Oil,	Seawater Circulation in Sewage Outfall Tunnels, W86-00017 5E	with Varied Lithology, W86-00036 2E
W86-00243 5C	OUTFALLS	PENALTY FUNCTION
Fisheries Resource Impacts from Spills of Oil or Hazardous Substances,	Initial Dilution for Outfall Parallel to Current, W86-00016 5B	Numerical Modelling of Subcritical Open Chan- nel Flow Using the K-epsilon Turbulence Model and the Penalty Function Finite Element Tech-
W86-00244 5C	OUTLETS	nique,
Arctic Marine Oilspill Program (AMOP)	Technique to Optimally Locate Multilevel In- takes for Selective Withdrawal Structures,	W86-00003 2E
Remote Sensing Study, W86-00258 7B	W86-00213 8A	PERCHED GROUND WATER
Use of Satellite Imagery for Tracking the Kur-	OVERDRAFT	Evaluation of Hydrologic Processes Affecting Soil Movement in the Hagerman Fauna Area,
distan Oil Spill,	Ground-Water Conditions in the Cottonwood-	Hagerman, Idaho,
W86-00291 7B	West Oakley Fan Area, South-Central Idaho, W86-00117 2F	W86-00119 2G
OISE RIVER		PERFORMANCE EVALUATION
Rapidity of RNA Synthesis in Human Cells; A Highly Sensitive Parameter for Water Cytotoxi-	OVERLAND FLOW Toxic Organics Removal Kinetics in Overland Flow Land Treatment,	Weir Jetty Performance: Hydraulic and Sedi- mentary Considerations, Hydraulic Model In-
city Evaluation, W86-00052 5A	W86-00057 5D	vestigation, W86-00152 8A
OKANAGAN RIVER	Snowmelt Induced Urban Runoff in Northern	
Estimation of Phosphorus Flux in a Regulated	Sweden,	PESTICIDE KINETICS Release of Endothall from Aquathol Granula
Channel,	W86-00097 2C	Aquatic Herbicide,
W86-00062 5A	PACIFIC AREA	W86-00068 50
OPEN-CHANNEL FLOW	Water Resources Data Hawaii, Other Pacific	Sediment-Water Interface in Modeling Pesti
Numerical Modelling of Subcritical Open Chan- nel Flow Using the K-epsilon Turbulence Model	Areas, Water Year 1981. Volume 2. Guam, Northern Mariana Islands, Federated States of	cides in Sedimentation Ponds, W86-00088 51
and the Penalty Function Finite Element Tech-	Micronesia, Palau Islands and American Samoa.	
nique, W86-00003 2E	W86-00130 7C	PESTICIDE RESIDUES Multiresidue Method for the Analysis and Veri
	PARAMECIUM	fication of Several Herbicides in Water,
OPERATING POLICIES Dynamic Model for Multireservoir Operation,	Passage of Selected Heavy Metals From Sphaer- otilus (Bacteria: Chlamydobacteriales) to Para-	W86-00046 5A
W86-00069 6A	mecium caudatum (Protozoa: Ciliata),	PESTICIDES
OPTIMIZATION	W86-00055 5C	Fate of Aldicarb, Aldicarb Sulfoxide, and Aldi
Storm Sewer Optimum Design, W86-00100 8B	PARTICULATE MATTER Sources, Composition, and Transport of Sus-	carb Sulfone in Floridan Groundwater, W86-00045
OREGON	pended Particulate Matter in Lower Cook Inlet and Northwestern Shelikof Strait, Alaska,	Ecosystem Approach to the Toxicology of Res
Analysis and Interpretation of Data Obtained in Tests of the Geothermal Aguifer at Klamath	W86-00150 2J	due Forming Xenobiotic Organic Substances i the Great Lakes,
Falls, Oregon,	Suspended Particulate Matter in Elliott Bay,	W86-00237 5
W86-00107 2F	W86-00151 2J	Mathematical Model, SERATRA, for Sediment
ORGANIC COMPOUNDS	PATH OF POLLUTANTS	Contaminant Transport in Rivers and Its Appl
In-Home Treatment Methods for Removing	Alternating Direction Galerkin Technique for Simulation of Contaminant Transport in Com-	cation to Pesticide Transport in Four Mile an Wolf Creeks in Iowa.
Volatile Organic Chemicals, W86-00010 5F	plex Groundwater Systems,	W86-00259 5
	W86-00072 5B	PHENOLS
Removal by Coagulation of Trace Organics from Mississippi River Water,	One-Dimensional Analytical Solutions for the	Analysis of Phenols by Chemical Derivatization
W86-00011 SE	Migration of a Three-Member Padionnolide	IV Ranid and Sensitive Method for Analysis

PHENOLS

21 Chlorophenols by Improved Chloroacetyla-	POINT POLLUTION SOURCES Point Sources-Nonpoint Sources Trading in the	POTENTIAL WATER SUPPLY
tion Procedure, W86-00002 5A	Lake Dillon Watershed.	Public Water Supplies in Gloucester County, N.J.,
Toxicity to Daphnia of the End Products of Wet	W86-00167 5B	W86-00174 2F
Oxidation of Phenol and Substituted Phenols, W86-00064 5D	POLICY MAKING Acid Rain: Does Science Dictate Policy or	POTENTIOMETRIC SURFACE Ground-Water Resources of Audrain County,
DUOCBUODIIC	Policy Dictate Science,	Missouri,
PHOSPHORUS Nitrogen and Phosphorus Speciation and Flux in	W86-00137 6E	W86-00113 2F
a Large Florida River Wetland System, W86-00080 2H	POLITICAL CONSTRAINTS Legal, Ethical, Economic and Political Aspects	PRECIPITATION Soil Moisture Content: Statistical Estimation of
Some Recent Adaptations and Applications of QUAL-II in the Northeast,	of Transfrontier Pollution, W86-00143 6E	Its Probability Distribution, W86-00021 2G
W86-00090 5B	POLLUTANT IDENTIFICATION	Marine Weather of the Inland Waters of West-
PHOSPHORUS FLUX	Microbiological Water Quality of Impound- ments: A Literature Review,	ern Washington,
Estimation of Phosphorus Flux in a Regulated Channel.	W86-00185 5A	W86-00165 2B
W86-00062 5A	Procedures for Handling and Chemical Analysis of Sediment and Water Samples,	Hydrological Yearbook: 1980. W86-00182 2A
PHYSICOCHEMICAL TREATMENT Advantages of Dissolved-Air Flotation for	W86-00198 5A	SCPP Data Collection and Analysis for the
Water Treatment,	Microcomputer Assisted Quality Assurance, W86-00203 5A	Period 1 September 1981 through 31 August
		1982, W86-00216 2B
PHYTOPLANKTON Seasonal Succession of Phytoplankton in Lake	Monitoring Marine Microbial Fouling. W86-00227 5A	Ground-Base Snow and Ice Crystal Observation
Constance, W86-00051 2H	Sampling Frequency - Microbiological Drinking	System Used in Sierra Nevada Winter Orogra-
Phytoplankton-Environmental Interactions in	Water Regulations: Final Report, W86-00245 5A	phic Storms, W86-00222 2B
Reservoirs, Volume II: Discussion of Workshop		Application of Probable Maximum Precipitation
Papers and Open Literature, W86-00206 2H	Addendum to Handbook for Sampling and Sample Preservation.	Estimates: United States East of the 105th Me-
PIEZOMETRIC HEAD	W86-00268 5A	ridian, W86-00229 2B
Two Algorithms For Parameter Estimation in Groundwater Flow Problems,	Sampling and Detection of Tagged Dredged Material.	Boulder Upslope Cloud Observation Experi-
W86-00044 2F	W86-00288 5A	ment.
PIPE FLOW	POLYCHLORINATED BIPHENYLS	W86-00261 2B
Energy Losses at Straight-Flow-Through Sewer Junctions,	Survey of Polychlorinated Biphenyls in Industri- al Effluents in Canada.	Poststorm Reconnaissance of Tropical Storm Chris,
W86-00103 8B	W86-00286 5B	W86-00279 2B
PLANNING Modeling Water Demands.	POLYCHLORINATED BIPHENYLS. *PLANT TISSUES	Cloud Physics Studies in the SCPP: Interim
W86-00270 6D	Assessment of Heavy Metals and PCB's at Se- lected Sludge Application Sites in Ontario,	Progress Report, 1983-84. W86-00305 3B
Water Demand, W86-00271 6D	W86-00102 5A	Structure of Cold Fronts Over California,
	PONDING	W86-00306 3B
Methodological Framework, W86-00272 6D	Infiltration Under Ponded Conditions: 1. Opti- mal Analytical Solution and Comparison with	Responses to Seeding Clouds with Dry Ice in the SCPP-1 Experiment,
Industrial Water Demands,	Experimental Observations, W86-00049 2G	W86-00307 3B
W86-00273 6D		PRECIPITATION FREQUENCY
Agricultural Water Demands, W86-00274 6D	PONDS Locations and Areas of Ponds and Carolina	Statistical Analysis of Precipitation Frequency
Municipal Water Demands,	Bays at the Savannah River Plant, W86-00263 2H	in the Conterminous United States, Including Comparisons with Precipitation Totals,
W86-00275 6D	Ponds and Lagoons of Horn and Petit Bois	W86-00020 2B
Programming Models for Regional Water	Islands, Mississippi, Gulf Islands National Sea-	PRECIPITATION INTENSITY
Demand Analysis, W86-00276 6D	shore: Their Physical Size, Literature Review and Recommendations for Future Research,	Areal Intensity-Duration-Frequency Curves: A Possible Way of Improving the Rainfall Input,
National Perspective in Water Demand Model-	W86-00278 2H	W86-00095 2B
ing,	POPULATION DYNAMICS	PREDICTION
W86-00277 6D	Present and Prospective Use of Water by the Manufacturing Industries of New Jersey,	Multiple Nonlinear Statistical Models for Runoff Simulation and Prediction.
PLANT POPULATIONS Impact of Water Level Changes on Woody Ri-	W86-00175 6D	W86-00035 2E
parian and Wetland Communities; Volume X:	POROUS MEDIA	PRESSURE DISTRIBUTION
Index and Addendum to Volumes I-VIII, W86-00254 2I	Dispersion in Anisotropic, Homogeneous, Porous Media,	B-Jumps at Abrupt Channel Drops, W86-00018
Impact of Water Level Changes on Woody Ri-	W86-00015 2F	
parian and Wetland Communities; Volume IX:	Advancement in Hydraulic Modeling of Porous	PRICES Water Demand.
The Alaska Region, W86-00292 21	Pavement Facilities, W86-00098 2E	W86-00271 6D
PLUMES	POROUS PAVEMENT	PRINCIPAL COMPONENT ANALYSIS
Surface Buoyant Jets in Steady and Reversing	Advancement in Hydraulic Modeling of Porous	Interannual Steamflow Variability in the United
Crossflows, W86,00014	Pavement Facilities, W86-00098 2E	States Based on Principal Components, W86-00076

PROCESS CONTROL New Concepts and Practices in Activated	RADIOACTIVE WASTES One-Dimensional Analytical Solutions for the	RAINWATER CATCHMENT SYSTEMS Rainwater Catchment Water Quality in Micro-
Sludge Process Control, W86-00221 5D	Migration of a Three-Member Radionuclide Decay Chain in a Multilayered Geologic	nesia, W86-00061 3B
PROJECT PLANNING	Medium, W86-00081 5B	RAMGANGA DAM RESERVOIR
Application of the STORM Model to Design Problems in Singapore and in Kaosiung, Repub-		Monitoring of Reservoir Volume Using Landsat Data.
lic of China,	Sorption Behaviour of 14C in Groundwater/ Rock and in Groundwater/Concrete Environ-	W86-00032 7C
W86-00086 6A	ments,	RAPPAHANNOCK RIVER
PROTOZOANS Inactivation of Naegleria gruberi Cysts by Chlo-	W86-00184 5B	Condensed Disaggregation Model for Incorpo-
rine Dioxide,	Utility of Single Species and Ecosystem Tests in Assessing the Environmental Impact of Radio-	rating Parameter Uncertainty Into Mouthly Res- ervoir Simulations,
W86-00066 5F	nuclide Ecotoxicants,	W86-00073 2E
PUBLIC HEALTH	W86-00235 5B	RATE MODELS
Wastewater Reuse and Exposure to Legionella Organisms,	RADIOSONDES	Characterization of Aerobic Chemical Processes
W86-00054 5C	STREX TOVS/Radiosonde Comparison, Part I:	in Reservoirs: Problem Description and Model Formulation,
Environmental Engineering,	TOVS/AVHRR and Radiosonde Inventory, W86-00187 7B	W86-00176 5B
W86-00188 . 5F		RECHARGE
PUBLIC POLICY	RADIUM	Analytical Solutions for Periodic Well Recharge
Survey of National and State Regulatory	Removing Barium and Radium Through Calci- um Cation Exchange,	in Rectangular Aquifers with Third-Kind
Agency Policy and Procedures for the Determi- nation of the Toxicity of Wastewater Effluents.	W86-00008 5F	Boundary Conditions, W86-00041 2F
W86-00211 6E	RAIN FORESTS	
PUGET SOUND	Interception Storage Capacities of Tropical	Natural Ground-Water-Recharge Data from Three Selected Sites in Harvey County, South-
Effects, Pathways, Processes, and Transforma-	Rainforest Canopy Trees,	Central Kansas,
tion of Puget Sound Contaminants of Concern,	W86-00037 2I	W86-00132 2F
W86-00293 5B	RAINFALL	RECONNAISSANCE
PULP AND PAPER INDUSTRY	Analysis of the Effects of Orography on Surface Rainfall by a Parameterized Numerical Model,	Analysis and Interpretation of Data Obtained in
Deposit Control Technology for Kraft Recov- ery Units,	W86-00023 2B	Tests of the Geothermal Aquifer at Klamath Falls, Oregon,
W86-00170 5D	V-i	W86-00107 2F
Industrial Water Demands,	Variance of the T-year Event in the Log Pear- son Type-3 Distribution,	RECREATION PLANNING
W86-00273 6D	W86-00031 2E	Preliminary Evaluation of Lake Susceptibility to
PULP WASTES	Synthesis of Radar Rainfall Data,	Water-Quality Degradation by Recreational
Deposit Control Technology for Kraft Recov-	W86-00084 2A	Use, Alpine Lakes Wilderness Area, Washington,
ery Units, W86-00170 5D	Data Management for Continuous Hydrologic	W86-00114 5C
PUMPING	Simulation,	RECTANGULAR AQUIFERS
Hydraulics of a Well Pumped with Linearly	W86-00093 2A	Analytical Solutions for Periodic Well Recharge
Decreasing Discharge, W86-00040 2F	Runoff, Sediment Transport, and Water Quality	in Rectangular Aquifers with Third-Kind Boundary Conditions,
	in a Northern Illinois Agricultural Watershed	W86-00041 2F
PUMPING PLANTS MeGee Creek Pumping Station Siphon, Pike	before Urban Development, 1979-81, W86-00133 2J	REGIONAL ANALYSIS
County, Illinois: Hydraulic Model Investigation,	Application of Brobable Maximum Brosinitation	Areal Intensity-Duration-Frequency Curves: A
W86-00219 8B	Application of Probable Maximum Precipitation Estimates: United States East of the 105th Me-	Possible Way of Improving the Rainfall Input, W86-00095 2B
PUMPS	ridian,	
Pointe Coupee Pumping Station Sump and Outlet Structure, Upper Pointe Coupee Loop	W86-00229 2B	Hydrological Regionalisation: A Question of
Area, Louisiana: Hydraulic Model Investigation,	RAINFALL DISTRIBUTION	Problem and Scale, W86-00096 2E
W86-00101 8C	Spatially Varying Rainfall and Floodrisk Analy- sis.	REGIONAL PLANNING
QUADRATIC MODELS	W86-00012 2E	Programming Models for Regional Water
Quadratic Model for Reservoir Management: Application to the Central Valley Project,	RAINFALL INTENSITY	Demand Analysis,
W86-00070 6A	Probabilistic Structure of Storm Surface Runoff,	W86-00276 6D
QUALITY CONTROL	W86-00083 2E	REGRESSION ANALYSIS
AWWA Survey of Inorganic Contaminants in	Areal Intensity-Duration-Frequency Curves: A	Data Management for Continuous Hydrologic Simulation.
Water Supplies.	Possible Way of Improving the Rainfall Input,	W86-00093 2A
W86-00009 5F	W86-00095 2B	Trend Analysis of Salt Load and Evaluation of
Microcomputer Assisted Quality Assurance, W86-00203 5A	RAINFALL-RUNOFF RELATIONSHIPS	the Frequency of Water-Quality Measurements
	Nonlinear Time-Variant Constrained Model for	for the Gunnison, the Colorado, and the Dolores Rivers in Colorado and Utah,
RADAR Synthesis of Radar Rainfall Data,	Rainfall-Runoff, W86-00022 2A	W86-00123 5B
W86-00084 2A		REGULATED FLOW
Outline of Severe Local Storms with the Mor-	Probabilistic Structure of Storm Surface Runoff, W86-00083 2E	Estimation of Phosphorus Flux in a Regulated
phology of Associated Radar Echoes,		Channel,
W86-00146 2B	Attempt to Implement SWMM in Tunisia, W86-00087 6A	W86-00062 5A
RADIOACTIVE WASTE DISPOSAL		REMOTE SENSING
Modification of Bell Canyon Test (BCT) 1-FF Grout.	Data Management for Continuous Hydrologic Simulation.	Monitoring of Reservoir Volume Using Landsa Data,
W86-00248 8G	W86-00093 2A	

REMOTE SENSING

STREX TOVS/Radiosonde Comparison, Part I:	RIPRAP	SALINE WATER INTRUSION
TOVS/AVHRR and Radiosonde Inventory, W86-00187 7B	Wave Stability Study of Riprap-Filled Cells: Hydraulic Model Investigation,	Seawater Circulation in Sewage Outfall Tunnels, W86-00017 5E
	W86-00283 8A	N. f. II. W. b Channels December Stands
Arctic Marine Oilspill Program (AMOP) Remote Sensing Study,	RIVER BASINS	Norfolk Harbor and Channels Deepening Study, Report 1: Physical Model Results, Chesapeake
W86-00258 7B	Discrete-Time Linear Cascade under Time Averaging,	Bay Hydraulic Model Investigation, W86-00266 2L
Boulder Upalope Cloud Observation Experi-	W86-00028 2A	
ment. W86-00261 2B	RIVERS	SALINITY Trend Analysis of Salt Load and Evaluation of
	Heterotrophic Slimes in Irish Rivers, Evaluation	the Frequency of Water-Quality Measurements
Use of Satellite Imagery for Tracking the Kur- distan Oil Spill,	of the Problem, W86-00053 5B	for the Gunnison, the Colorado, and the Dolores Rivers in Colorado and Utah,
W86-00291 7B	Walanahan Associated with Supported	W86-00123 5B
REPTILES	Hydrocarbons Associated with Suspended Matter in the Green River, Washington,	SAMPLE PREPARATION
Large-Scale Operations Management Test of	W86-00196 5B	Addendum to Handbook for Sampling and
Use of the White Amur for Control of Problem Aquatic Plants: The Herpetofauna of Lake	Development of a Numerical Modeling Capabil-	Sample Preservation. W86-00268 5A
Conway, Species Accounts,	ity for the Computation of Unsteady Flow on	
W86-00202 6G	the Ohio River and Its Major Tributaries, W86-00220 2E	SAMPLING Microbiological Water Quality of Impound-
RESERVOIR FISHERIES		ments: A Literature Review,
Review of the Effects of Water-Level Changes	Opportunities to Protect Instream Flows in	W86-00185 5A
on Reservoir Fisheries and Recommendations for Improved Management,	Alaska, W86-00280 6E	Procedures for Handling and Chemical Analysis
W86-00158 6G		of Sediment and Water Samples,
	RNA SYNTHESIS Rapidity of RNA Synthesis in Human Cells; A	W86-00198 5A
RESERVOIR OPERATION Dynamic Model for Multireservoir Operation,	Highly Sensitive Parameter for Water Cytotoxi-	Sampling Frequency - Microbiological Drinking
W86-00069 6A	city Evaluation,	Water Regulations: Final Report,
Quadratic Model for Reservoir Management:	W86-00052 5A	W86-00245 5A
Application to the Central Valley Project,	ROOT-WATER-UPTAKE MODELS	Addendum to Handbook for Sampling and
W86-00070 6A	Comparing the Performance of Root-Water- Uptake Models,	Sample Preservation. W86-00268 5A
RESERVOIR STORAGE	W86-00048 2D	
Monitoring of Reservoir Volume Using Landsat		SAND MULCH
Data,	RUNOFF Determination of Resistance Parameters of	Soil Water Evaporation Suppression by Sand Mulches.
W86-00032 7C	Pluvio-Nivo-Glacial Alpine Systems by Mathe-	W86-00050 2G
RESERVOIRS	matical Modeling of Runoff,	SATELLITE TECHNOLOGY
Condensed Disaggregation Model for Incorpo- rating Parameter Uncertainty Into Mouthly Res-	W86-00034 2E	Monitoring of Reservoir Volume Using Landsat
ervoir Simulations,	Multiple Nonlinear Statistical Models for Runoff	Data,
W86-00073 2E	Simulation and Prediction, W86-00035 2E	W86-00032 7C
Microbiological Water Quality of Impound-		STREX TOVS/Radiosonde Comparison, Part I:
ments: A Literature Review,	Estimates of Peak Runoff from Hilly Terrain with Varied Lithology,	TOVS/AVHRR and Radiosonde Inventory, W86-00187 7B
W86-00185 5A	W86-00036 2E	
User Guide for LARM2: A Longitudinal-Verti-	Runoff from Glacierized Mountains: A Model	Arctic Marine Oilspill Program (AMOP) Remote Sensing Study,
cal, Time-Varying Hydrodynamic Reservoir Model.	for Annual Variation and Its Forecasting,	W86-00258 7B
W86-00190 5B	W86-00077 2E	Use of Satellite Imagery for Tracking the Kur-
Phytoplankton-Environmental Interactions in	Unit Hydrograph Approximations Assuming	distan Oil Spill,
Reservoirs, Volume II: Discussion of Workshop	Linear Flow Through Topologically Random	W86-00291 7B
Papers and Open Literature,	Channel Networks, W86-00082 2E	SATURATED ZONE
W86-00206 2H		Block-Geometry Functions Characterizing Transport in Densely Fissured Media,
Technique to Optimally Locate Multilevel In-	Data Management for Continuous Hydrologic Simulation.	W86-00039 2F
takes for Selective Withdrawal Structures, W86-00213	W86-00093 2A	77.77
	Hydrological Regionalisation: A Question of	SEA GRASSES Effects of Oil on Seagrass Ecosystems,
Grays Landing Spillway and Stilling Basin,	Problem and Scale,	W86-00241 5C
Monongahela River, Pennsylvania: Hydraulic Model Investigation,	W86-00096 2E	SEASONAL DISTRIBUTION
W86-00304 8B	Showhich induced Croan Ranon in Hornier	Method of Predicting Daily Peak Flows in the
RETAINING WALLS	Sweden,	High-Flow Season, W86-00027 2E
Program Criteria Specifications Document:		
Computer Program TWDA for Design and Analysis of Inverted-T Retaining Walls and	a mining and ampropriate or a second	Sources, Composition, and Transport of Sus-
Floodwalls,	Stormwater Management Facilities in Montgom- ery County, Maryland,	pended Particulate Matter in Lower Cook Inlet and Northwestern Shelikof Strait, Alaska,
W86-00193 8A	W86-00099 4A	W86-00150 2J
REVERSE OSMOSIS	Hydrological Yearbook: 1980.	SEASONAL VARIATION
High-Temperature Desalination Capability of	W86-00182 2A	Seasonal Succession of Phytoplankton in Lake
TFC 1501 Reverse Osmosis Element, W86-00265 3A	SALINE-FRESHWATER INTERFACE	Constance, W86-00051 2H
48.7	Regional Unsteady Interface Between Fresh	THE PERSON OF THE PERSON OF
REVIEWS	Water and Salt Water in a Confined Coastal Aquifer.	SEAWATER
Chemistry for Operators,		Seawater Circulation in Sewage Outfall Tunnels

SECONDARY WASTEWATER TREATMENT	Review of Case Studies of CREAMS Model	SEWER SYSTEMS
Effects on Groundwater Quality of the Intro-	Application,	Application of the STORM Model to Design
duction of Secondary Sewage Treatment to an	W86-00302 5B	Problems in Singapore and in Kaosiung, Repub-
Effluent Recharge Site on the Chalk of Southern England,	SEDIMENTARY BASINS (GEOLOGIC)	lic of China,
W86-00043 5D	Stratigraphy and Sedimentary Facies of the	W86-00086 6A
W 80-000+3	Madison Limestone and Associated Rocks in	Storm Sewer Optimum Design,
SEDIMENT DISCHARGE	Parts of Montana, Nebraska, North Dakota,	W86-00100 8B
Runoff, Sediment Transport, and Water Quality	South Dakota, Wyoming,	W 00-00100
in a Northern Illinois Agricultural Watershed	W86-00104 2F	Energy Losses at Straight-Flow-Through Sewer
before Urban Development, 1979-81,		Junctions,
W86-00133 2J	SEDIMENTATION	W86-00103 8B
SEDIMENT DISPOSAL	Sediment-Water Interface in Modeling Pesti-	
Long-Term Impact of Dredged Material Dispos-	cides in Sedimentation Ponds,	SEWERS
al in Lake Erie off Ashtabula, Ohio,	W86-00088 5B	Environmental Engineering,
W86-00162 5C	Water-Quality Appraisal, Mammoth Creek and	W86-00188 5F
W 80-00102	Hot Creek, Mono County, California,	SHOALS
SEDIMENT TRANSPORT	W86-00106 5A	Sand Resources and Geological Character of
Transport of Suspended Material in Open and		Long Island Sound,
Submerged Streams,	SEDMNT: A Sediment Transport Submodel	W86-00205 8E
W86-00013 2J	Based on Hydrodynamic Principles for the Uni-	
Codiment Water Interfers in Madeline Best	fied Transport Model,	SHORE PROTECTION
Sediment-Water Interface in Modeling Pesti- cides in Sedimentation Ponds,	W86-00155 2J	Shore Stabilization with Salt Marsh Vegetation,
W86-00088 5B	SEDIMENTATION BASINS	W86-00189 8G
W 80-00065	Sediment-Water Interface in Modeling Pesti-	
Sediment Transport by Irrigation Return Flows	cides in Sedimentation Ponds,	Sand Resources and Geological Character of
in Four Small Drains Within the DID-18 Drain-	W86-00088 5B	Long Island Sound,
age of the Sulphur Creek Basin, Yakima County,	W 60-00060 3B	W86-00205 8E
Washington, April 1979 to October 1981,	SEDIMENTS	Effects of Booch Manishment on the Manusham
W86-00112 2J	Laboratory and Field Studies on the Fate of	Effects of Beach Nourishment on the Nearshore Environment in Lake Huron at Lexington
2	1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and	Harbor (Michigan),
Preliminary Appraisal of Sediment Sources and	Sediments,	W86-00224 6G
Transport in Kings Bay and Vicinity, Georgia and Florida.	W86-00047 5B	W 00-00224 0G
and Florida, W86-00125 2J		Mission Bay Harbor, California, Design for
W80-00125	Long-Term Impact of Dredged Material Dispos-	Wave and Surge Protection and Flood Control:
Sources, Composition, and Transport of Sus-	al in Lake Erie off Ashtabula, Ohio,	Hydraulic Model Investigation,
pended Particulate Matter in Lower Cook Inlet	W86-00162 5C	W86-00255 8B
and Northwestern Shelikof Strait, Alaska,	Procedures for Handling and Chemical Analysis	
W86-00150 2J	of Sediment and Water Samples,	Edgewater Marina, Cleveland, Ohio: Design for
	W86-00198 5A	Wave Protection, Hydraulic Model Investiga-
SEDMNT: A Sediment Transport Submodel	W 00-00170	tion,
Based on Hydrodynamic Principles for the Uni-	Sand Resources and Geological Character of	W86-00256 8B
fied Transport Model,	Long Island Sound,	Design for Descention of Basels Esseion of
W86-00155 2J	W86-00205 8E	Design for Prevention of Beach Erosion at Presque Isle Beaches, Erie, Pennsylvania: Hy-
Mathematical Model, SERATRA, for Sediment-		draulic Model Investigation,
Contaminant Transport in Rivers and Its Appli-	SEEPAGE	W86-00257 8B
cation to Pesticide Transport in Four Mile and	Groundwater Seepage Nutrient Loading in a	W 60-00237
Wolf Creeks in Iowa.	Florida Lake,	SHORELINE CHANGES
W86-00259 5B	W86-00065 2H	Historical Changes to Lake Washington and
	User's Guide for a Plane and Axisymmetric	Route of the Lake Washington Ship Canal, King
Sampling and Detection of Tagged Dredged	Finite Element Program for Steady-State Seep-	County, Washington,
Material,	age Problems,	W86-00105 2H
W86-00288 5A	W86-00156 2G	
SEDIMENT YIELD		SHORELINES
Runoff, Sediment Transport, and Water Quality	Seepage Analysis Using the Boundary Element	Historical Changes to Lake Washington and
in a Northern Illinois Agricultural Watershed	Method,	Route of the Lake Washington Ship Canal, King
before Urban Development, 1979-81,	W86-00228 2G	County, Washington,
W86-00133 2J	CPPD LOP TOCK	W86-00105 2H
***************************************	SEEPAGE LOSS	SIMULATION
European and United States Case Studies in	Evaluation of Hydrologic Processes Affecting	
Application of the CREAMS Model.	Soil Movement in the Hagerman Fauna Area,	Comparison of Two Daily Streamflow Simula
W86-00294 5B	Hagerman, Idaho,	tion Models of an Alpine Watershed, W86-00033
	W86-00119 2G	W86-00033 2E
CREAMS: A System for Evaluating Manage-	SEINE RIVER	Condensed Disaggregation Model for Incorpo
ment Practices on Field-Size Areas,	Rapidity of RNA Synthesis in Human Cells; A	
W86-00295 5B	Highly Sensitive Parameter for Water Cytotoxi-	
Testing the Application of CREAMS to Finnish	city Evaluation,	W86-00073 2E
Conditions,	W86-00052 5A	The state of the s
W86-00296 5B		SIMULATION ANALYSIS
	SEWAGE EFFLUENTS	Spatially Varying Rainfall and Floodrisk Analy
Predicting Hillslope Runoff and Erosion in the	Nutrient Input from the Loxahatchee River En-	
United Kingdom: Preliminary Trials with the	vironmental Control District Sewage-Treatment	
CREAMS Model,	Plant to the Loxahatchee River Estuary, South-	Manhadala Cinadala da Comunica da No
W86-00300 5B	eastern Florida,	Mechanistic Simulation for Transport of Non
Application of the CREAMS Model as Part of	W86-00110 5E	
an Overall System for Optimizing Environmen-		W86-00092
tal Management in Lithuania, USSR: First Ex-		Advancement in Hydraulic Modeling of Porou
periments,	Junctions,	Pavement Facilities,
W86-00301 5B		

SIMULATION ANALYSIS

Atchafalaya River Delta; Report 8: Numerical Modeling of Hurricane-Induced Storm Surge,	Analysis of Inverted-T Retaining Walls and Floodwalls,	SPILLS Ethylene: Environmental and Technical Infor-
W86-00164 2A	W86-00193 8A	mation for Problem Spills.
SIPHONS	List of Soils, Soil-Structure Interaction and	W86-00303 5C
MeGee Creek Pumping Station Siphon, Pike	Other Related Computer Programs Available	SPILLWAYS
County, Illinois: Hydraulic Model Investigation,	for LMVD Engineers, W86-00262 8D	Barkley Dam Spillway Tainter Gate and Emer-
W86-00219 8B	W86-00262 8D	gency Bulkheads, Cumberland River, Kentucky:
SLIMES	Wave Stability Study of Riprap-Filled Cells:	Hydraulic Model Investigation, W86-00284 8C
Heterotrophic Slimes in Irish Rivers, Evaluation	Hydraulic Model Investigation, W86-00283 8A	W 80-00284
of the Problem,		Bloomington Spillway North Branch Potomac
W86-00053 5B	SOIL WATER	River Maryland and West Virginia: Hydraulic
SLUDGE DISPOSAL	Soil Moisture Content: Statistical Estimation of Its Probability Distribution.	Model Investigation, W86-00285 8B
Assessment of Heavy Metals and PCB's at Se-	W86-00021 2G	
lected Sludge Application Sites in Ontario, W86-00102 5A	Field Observations and Numerical Experiments	Grays Landing Spillway and Stilling Basin,
	on a Drying Front in a Volcanic Ash Soil Called	Monongahela River, Pennsylvania: Hydraulic Model Investigation,
Environmental Engineering, W86-00188 5F	Kanto Loam,	W86-00304 8B
W86-00188 5F	W86-00038 2F	CAL A MIDWING ECTI A DAY
SLUDGE TREATMENT	Comparing the Performance of Root-Water-	ST. LAWRENCE ESTUARY Heavy Metal Accumulation (Cd, Cu, Pb and
Environmental Engineering,	Uptake Models,	Zn) by Smelt (Osmerus mordax) From the
W86-00188 5F	W86-00048 2D	North Shore of the St Lawrence Estuary (Accu-
SLUDGE UTILIZATION	Soil Water Evaporation Suppression by Sand	mulation de Quelques Metaux Lourds (Cd, Cu,
Assessment of Heavy Metals and PCB's at Se-	Mulches, W86-00050 2G	Pb Et Zn) Chez L'Eperlan (Osmerus mordax) Preleve Sur La Rive Nord De L'Estuaire du
lected Sludge Application Sites in Ontario, W86-00102 5A	11.00	Saint-Laurent),
	Numerical Calculation of Saturated-Unsaturated	W86-00059 5C
SMELT COLOR PLANT	Infiltration in a Cracked Soil, W86-00078 2G	STANDARDS
Heavy Metal Accumulation (Cd, Cu, Pb and Zn) by Smelt (Osmerus mordax) From the		Development Document for Effluent Limita-
North Shore of the St Lawrence Estuary (Accu-	SOIL WATER MOVEMENT Seepage Analysis Using the Boundary Element	tions Guidelines and Standards for the Textile
mulation de Quelques Metaux Lourds (Cd, Cu,	Method,	Mills Point Source Category.
Pb Et Zn) Chez L'Eperlan (Osmerus mordax) Preleve Sur La Rive Nord De L'Estuaire du	W86-00228 2G	W86-00207 5G
Saint-Laurent),	SOIL-WATER-PLANT RELATIONSHIPS	Survey of National and State Regulatory
W86-00059 5C	Impact of Water Level Changes on Woody Ri-	Agency Policy and Procedures for the Determi-
SNOW	parian and Wetland Communities; Volume X: Index and Addendum to Volumes I-VIII,	nation of the Toxicity of Wastewater Effluents. W86-00211 6E
Ground-Base Snow and Ice Crystal Observation	W86-00254 2I	
System Used in Sierra Nevada Winter Orogra-	Innert of Water I and Change on Woods Bi	STATE WATER ISSUES
phic Storms, W86-00222 2B	Impact of Water Level Changes on Woody Ri- parian and Wetland Communities; Volume IX:	National Water Summary 1983Hydrologic Events and Issues.
	The Alaska Region,	W86-00131 6B
SNOWMELT Runoff from Glacierized Mountains: A Model	W86-00292 2I	OF A PROPERTY AND A TWO TO
for Annual Variation and Its Forecasting,	SOLID WASTE DISPOSAL	STATISTICAL ANALYSIS Statistical Analysis of Precipitation Frequency
W86-00077 2E	Long-Term Impact of Dredged Material at Two	in the Conterminous United States, Including
Snowmelt Induced Urban Runoff in Northern	Open-Water Sites: Lake Erie and Elliot Bay; Evaluative Summary,	Comparisons with Precipitation Totals,
Sweden,	W86-00160 5C	W86-00020 2B
W86-00097 2C	SOLUTE TRANSPORT	Soil Moisture Content: Statistical Estimation of
SNOWPACK	Block-Geometry Functions Characterizing	Its Probability Distribution,
Snowmelt Induced Urban Runoff in Northern	Transport in Densely Fissured Media,	W86-00021 2G
Sweden,	W86-00039 2F	Regional Frequency Analysis of Multiyear
W86-00097 2C	Alternating Direction Galerkin Technique for	Droughts Using Watershed and Climatic Infor-
SOCIAL IMPACT	Simulation of Contaminant Transport in Com- plex Groundwater Systems,	mation, W86-00025 2A
Water and the City,	W86-00072 5B	
W86-00264 6D		Statistical Choice of Extremal Models for Com-
SOIL SOIL	Computer Modeling of Hydrodynamics and Solute Transport in Canals and Marinas: Litera-	plete and Censored Data, W86-00026 2A
Laboratory and Field Studies on the Fate of 1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and	ture Review and Guidelines for Future Develop-	W 80-00020
Sediments,	ment,	Estimation of Missing Values in Monthly Rain-
W86-00047 5B	W86-00179 5B	fall Series, W86-00094 2B
SOIL CONSERVATION	SORPTION	
ANSWERS (Areal Nonpoint Source Watershed	Sorption Behaviour of 14C in Groundwater/ Rock and in Groundwater/Concrete Environ-	STATISTICAL METHODS
Environment Response Simulation) User's	ments,	Trend Analysis of Salt Load and Evaluation of the Frequency of Water-Quality Measurements
Manual. W86-00287 4D	W86-00184 5B	for the Gunnison, the Colorado, and the Dolores
	SPAIN	Rivers in Colorado and Utah,
SOIL EROSION	Estimates of Peak Runoff from Hilly Terrain	W86-00123 5B
Review of Model Use in Evaluating Nonpoint Source Loads from Forest Management Activi-	with Varied Lithology, W86-00036 2E	Microcomputer Assisted Quality Assurance,
ties,		W86-00203 5A
W86-00091 5B		
	SPHAEROTILUS Passage of Selected Heavy Metals From Sphaer	STATISTICAL MODELS
SOIL MECHANICS	Passage of Selected Heavy Metals From Sphaer- otilus (Bacteria: Chlamydobacteriales) to Para-	STATISTICAL MODELS Multiple Nonlinear Statistical Models for Runoff
SOIL MECHANICS Program Criteria Specifications Document: Computer Program TWDA for Design and	Passage of Selected Heavy Metals From Sphaer-	

Estimation of Missing Values in Monthly Rainfall Series,	STREAMFLOW Discrete-Time Linear Cascade under Time	SUCCESSION Seasonal Succession of Phytoplankton in Lake
W86-00094 2B	Averaging,	Constance,
STEEL Preventative Measures to Limit Stress Corrosion	W86-00028 2A Gould's Probability Matrix Method; 1. The	W86-00051 2H SUMPS
Cracking in Prestressed Concrete, W86-00249	Starting Month Problem, W86-00029 2E	Pointe Coupee Pumping Station Sump and Outlet Structure, Upper Pointe Coupee Loop
STILLING BASINS Pointe Coupee Pumping Station Sump and	Gould's Probability Matrix Method; 2. The	Area, Louisiana: Hydraulic Model Investigation, W86-00101 8C
Outlet Structure, Upper Pointe Coupee Loop Area, Louisiana: Hydraulic Model Investigation W86-00101	Annual Autocorrelation Problem,	SURFACE-GROUNDWATER RELATIONSHIPS Availability of Water from the Alluvial Aquifer in Part of the Green River Valley, King County,
STOCHASTIC HYDROLOGY Effects of Incorrectly Removed Periodicity in	tion Models of an Alpine Watershed,	Washington, W86-00126 2F
Parameters on Stochastic Dependence, W86-00075	Interannual Steamflow Variability in the United States Based on Principal Components,	SURFACE RUNOFF Hydrological Regionalisation: A Question of
Estimation of Missing Values in Monthly Rain fall Series,	W86-00076 2E	Problem and Scale, W86-00096 2E
W86-00094 2E STOCHASTIC PROCESS	Runoff from Glacierized Mountains: A Model for Annual Variation and Its Forecasting, W86-00077 2E	Snowmelt Induced Urban Runoff in Northern Sweden,
Estimation of Missing Values in Monthly Rain fall Series,	Minimum Variance Streamflow Record Aug-	W86-00097 2C Advancement in Hydraulic Modeling of Porous
STORM RUNOFF	W86-00079 2E	Pavement Facilities, W86-00098 2E
Probabilistic Structure of Storm Surface Runoft W86-00083 21	Problem and Scale,	SURFACE WATER Quality of Water, Quillayute River Basin, Wash-
Attempt to Implement SWMM in Tunisia, W86-00087 6A	W86-00096 2E STREAMFLOW GAINS	ington, W86-00111 2K
Advancement in Hydraulic Modeling of Porou	Streamflow Losses Along the Balcones Fault	Water Resources Data for Florida, Water Year
Pavement Facilities, W86-00098 21	Zone, Nueces River Basin, Texas, W86-00124 2E	1981 Volume 1: Northeast Florida. W86-00127
Planning and Implementation of Regions Stormwater Management Facilities in Montgom ery County, Maryland,	Streamflow Losses Along the Balcones Fault Zone, Nueces River Basin, Texas,	Water Resources Data for Colorado, Water Year 1982, Volume 2. Colorado River Basin above Dolores River,
W86-00099	by magnificant and a world	W86-00128 7C
Runoff, Sediment Transport, and Water Qualit in a Northern Illinois Agricultural Watershe before Urban Development, 1979-81, W86-00133	Stream Channel Stability Assessment,	Water Resources Data, North Dakota, Water Year 1981, Volume 1. Hudson Bay Basin. W86-00129 7C
STORM SEWERS	Stream Water Quality in the Coal Region of	Water Resources Data Hawaii, Other Pacific Areas, Water Year 1981. Volume 2. Guam.
Storm Sewer Optimum Design, W86-00100 8	Alabama and Georgia, W86-00250 5B	Northern Mariana Islands, Federated States of Micronesia, Palau Islands and American Samoa
STORM WARNINGS	Guide to Stream Habitat Analysis Using the Instream Flow Incremental Methodology,	W86-00130 7C
Outline of Severe Local Storms with the Mo phology of Associated Radar Echoes, W86-00146 2	W86-00251 6G	SURFACE WATER AVAILABILITY Water Resources on the Pueblo of Laguna West-Central New Mexico,
STORM WASTEWATER	Stream Water Quality in the Coal Region of West Virginia and Maryland,	W86-00108 2F
Flow Balancing Method for Stormwater ar Combined Sewer Overflow. W86-00191 5	April 40	SURFACE-WATER DISCHARGE Time-of-Travel Data for Nebraska Streams
STORM WATER	Contaminant Transport in Rivers and Its Appli- cation to Pesticide Transport in Four Mile and	1968 to 1977, W86-00120 2E
	Wolf Creeks in Iowa. W86-00259 5B	SURVEYS Water Utility Operating Data: An Analysis,
Outline of Severe Local Storms with the Mo	Omo,	W86-00004 6E AWWA Survey of Inorganic Contaminants in
phology of Associated Radar Echoes, W86-00146	B W86-00267 5B	Water Supplies.
Poststorm Reconnaissance of Tropical Stor	m Stream Water Quality in the Coal Region of Pennsylvania,	Engineering Condition Survey of Concrete in
Chris, W86-00279	B W86-00281 5B	Service,
STRATIGRAPHY Stratigraphy and Sedimentary Facies of t Madison Limestone and Associated Rocks Parts of Montana, Nebraska, North Dako	structural engineering program criteria Specifications Document: Computer Program TWDA for Design and Analysis of Inverted-T Retaining Walls and	SUSPENDED LOAD Evaluation of a Hydrograph Shifting Methofor Estimating Suspended-Sediment Loads in II
South Dakota, Wyoming, W86-00104	Floodwalls, W86-00193	linois Streams, W86-00115
STREAM POLLUTION Assessment of Water Resources in Lead-Zi Mined Areas in Cherokee County, Kansas, a	Buhne Point, Humboldt Bay, California, Design for the Prevention of Shoreline Erosion: Hy-	Transport in Kings Bay and Vicinity, Georgi
Adjacent Areas,	draulic and Numerical Model Investigations, A W86-00169 4D	and Florida, W86-00125

SUSPENDED SEDIMENT

Suspended Particulate Matter in Elliott Bay, W86-00151 2J	Norfolk Harbor and Channels Deepening Study,	W86-00234 the Watershed Level,
SUSPENDED SEDIMENTS	Report 1: Physical Model Results, Chesapeake Bay Hydraulic Model Investigation,	Utility of Single Species and Ecosystem Tests in
Transport of Suspended Material in Open and	W86-00266 2L	Assessing the Environmental Impact of Radio- nuclide Ecotoxicants,
Submerged Streams, W86-00013 2J	Functional Design of Control Structures for	W86-00235 5B
Calles Shaullers and reality of selling	Oregon Inlet, North Carolina: Hydraulic Model	Classes of Ecotoxicological Tests: Their Advan-
Evaluation of a Hydrograph Shifting Method for Estimating Suspended-Sediment Loads in Il-	Investigation, W86-00269 8B	tages and Disadvantages for Regulation, W86-00236 5C
linois Streams, W86-00115 2J	TIDAL HYDRAULICS	Ecosystem Approach to the Toxicology of Resi-
THE PARTY OF THE P	Atchafalaya River Delta; Report 8: Numerical Modeling of Hurricane-Induced Storm Surge,	due Forming Xenobiotic Organic Substances in
Techniques to Reduce the Sediment Resuspen- sion Caused by Dredging,	W86-00164 2A	the Great Lakes, W86-00237 5B
W86-00159 5G	TIME-OF-TRAVEL MEASUREMENTS	
SUSPENDED SOLIDS	Time-of-Travel Data for Nebraska Streams, 1968 to 1977.	TRADING Point Sources-Nonpoint Sources Trading in the
Suspended Particulate Matter in Elliott Bay, W86-00151 2J	W86-00120 2E	Lake Dillon Watershed. W86-00167 5B
	TIME SERIES ANALYSIS	
Techniques to Reduce the Sediment Resuspen- sion Caused by Dredging.	Effects of Incorrectly Removed Periodicity in	Volunteer Lake Monitoring, 1981,
W86-00159 5G	Parameters on Stochastic Dependence, W86-00075	W86-00200 5C
Hydrocarbons Associated with Suspended		TRANSPORT EQUATIONS
Matter in the Green River, Washington,	Estimation of Missing Values in Monthly Rainfall Series.	Evaluation of a Hydrograph Shifting Method
W86-00196 5B	W86-00094 2B	for Estimating Suspended-Sediment Loads in Il- linois Streams,
SWITZERLAND	TOPOGRAPHY	W86-00115 2J
Seasonal Succession of Phytoplankton in Lake Constance.	Estimates of Peak Runoff from Hilly Terrain with Varied Lithology,	TRANSPORTATION
W86-00051 2H	W86-00036 2E	Channel Widths in Bends and Straight Reaches
TEMPERATURE	TOTAL PRECIPITATION	Between Bends for Push Towing: Hydraulic Model Investigation,
Foundations of Principal Component Selection	Statistical Analysis of Precipitation Frequency	W86-00225 8B
Rules, W86-00186 7C	in the Conterminous United States, Including Comparisons with Precipitation Totals,	TREES
	W86-00020 2B	Interception Storage Capacities of Tropical Rainforest Canopy Trees,
TENNESSEE Spatially Varying Rainfall and Floodrisk Analy-	TOXIC SUBSTANCES	W86-00037 2I
sis,	Toxic Organics Removal Kinetics in Overland	TREND ANALYSIS
W86-00012 2E	Flow Land Treatment, W86-00057 5D	Trend Analysis of Salt Load and Evaluation of
TESTING PROCEDURES	TOXIC WASTES	the Frequency of Water-Quality Measurements for the Gunnison, the Colorado, and the Dolores
Laboratory Protocols for Evaluating the Fate of Organic Chemicals in Air and Water,	Survey of National and State Regulatory	Rivers in Colorado and Utah,
W86-00154 5A	Agency Policy and Procedures for the Determi- nation of the Toxicity of Wastewater Effluents.	W86-00123 5B
TEXAS	W86-00211 6E	TUNISIA
Streamflow Losses Along the Balcones Fault	Working Papers Prepared as Background for	Estimates of Peak Runoff from Hilly Terrain with Varied Lithology,
Zone, Nueces River Basin, Texas, W86-00124 2E	Testing for Effects of Chemicals on Ecosystems.	W86-00036 2E
	W86-00230 5C	TURBULENT FLOW
TEXTILE MILL WASTES Development Document for Effluent Limita-	TOXICITY	Numerical Modelling of Subcritical Open Chan- nel Flow Using the K-epsilon Turbulence Model
tions Guidelines and Standards for the Textile	Toxicity to Daphnia of the End Products of Wet Oxidation of Phenol and Substituted Phenols,	and the Penalty Function Finite Element Tech-
Mills Point Source Category. W86-00207 5G	W86-00064 5D	nique, W86-00003 2E
	Survey of National and State Regulatory	
THIRD-KIND BOUNDARY CONDITIONS Analytical Solutions for Periodic Well Recharge	Agency Policy and Procedures for the Determi- nation of the Toxicity of Wastewater Effluents.	ULTRAVIOLET ABSORPTION Tracer Applications of Ultra-Violet Absorption
in Rectangular Aquifers with Third-Kind	W86-00211 6E	Measurements in Coastal Waters,
Boundary Conditions, W86-00041 2F	Effects, Pathways, Processes, and Transforma-	W86-00056 2L
	tion of Puget Sound Contaminants of Concern,	UNIT HYDROGRAPHS Unit Hydrograph Approximations Assuming
THROUGHFALL Interception Storage Capacities of Tropical	W86-00293 5B	Linear Flow Through Topologically Random
Rainforest Canopy Trees,	Ethylene: Environmental and Technical Infor- mation for Problem Spills.	Channel Networks, W86-00082 2E
W86-00037 2I	W86-00303 5C	
THUNDERSTORMS	TOXICITY TESTING	UNITED STATES AWWA Survey of Inorganic Contaminants in
Outline of Severe Local Storms with the Mor- phology of Associated Radar Echoes.	Rapidity of RNA Synthesis in Human Cells; A	Water Supplies.
W86-00146 2B	Highly Sensitive Parameter for Water Cytotoxi- city Evaluation,	W86-00009 5F
TIDAL CURRENTS	W86-00052 5A	National Water Summary 1983Hydrologic Events and Issues.
Effects of Spatial Variation in Amplitude and	TOXICOLOGY	W86-00131 6E
Phase of the Oscillatory Tidal Currents on the Residual Lagrangian Drifts,	Methods for Ecological Toxicology: A Critical Review of Laboratory Multispecies Tests.	UPPER SPRING CREEK WATERSHED
W86-00085 2L	W86-00210 5C	Runoff, Sediment Transport, and Water Quality
Circulation in the Lower Cook Inlet, Alaska,	Optimum Microcosms for Lake Ecotoxicology,	in a Northern Illinois Agricultural Watersher before Urban Development, 1979-81,
W86-00149 2L	W86-00232 5C	W86-00133

UPPER TIBER RIVER BASIN	VOLATILE COMPOUNDS	Deposit Control Technology for Kraft Recov-
Analysis of the Effects of Orography on Surface	In-Home Treatment Methods for Removing	ery Units,
Rainfall by a Parameterized Numerical Model, W86-00023 2B	Volatile Organic Chemicals, W86-00010 5F	W86-00170 5D
		Environmental Engineering,
URANIUM	VOLCANIC ASH SOIL	W86-00188 5F
Karnes County, Texas, Area Hydrochemical and Stream Uranium Orientation Study,	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called	Flow Belowing Mathed for Street, and
W86-00194 2K	Kanto Loam,	Flow Balancing Method for Stormwater and Combined Sewer Overflow.
URANIUM MILL TAILINGS	W86-00038 2F	W86-00191 5D
Long-Term Ecological Behaviour of Aban-	WASHINGTON	
doned Uranium Mill Tailings; 2.: Growth Pat-	Historical Changes to Lake Washington and	Hydrocarbons Associated with Suspended Matter in the Green River, Washington,
terns of Indigenous Vegetation on Terrestrial	Route of the Lake Washington Ship Canal, King	W86-00196 5B
and Semi-Aquatic Areas, W86-00217 5C	County, Washington, W86-00105 2H	
	W 80-00103 2H	Oil Shale Mining, Processing, Uses, and Envi-
URBAN RUNOFF Application of the STORM Model to Design	Quality of Water, Quillayute River Basin, Wash-	ronmental Impacts, 1978-July, 1981: Citations from the NTIS Data Base.
Problems in Singapore and in Kaosiung, Repub-	ington, W86-00111 2K	W86-00201 4C
lic of China,		
W86-00086 6A	Sediment Transport by Irrigation Return Flows	Microcomputer Assisted Quality Assurance, W86-00203 5A
Attempt to Implement SWMM in Tunisia,	in Four Small Drains Within the DID-18 Drain- age of the Sulphur Creek Basin, Yakima County,	W86-00203 5A
W86-00087 6A	Washington, April 1979 to October 1981,	Development Document for Effluent Limita-
Snowmelt Induced Urban Runoff in Northern	W86-00112 2J	tions Guidelines and Standards for the Textile
Sweden,	Preliminary Evaluation of Lake Susceptibility to	Mills Point Source Category. W86-00207 5G
W86-00097 2C	Water-Quality Degradation by Recreational	W 60-00207
Advancement in Hydraulic Modeling of Porous	Use, Alpine Lakes Wilderness Area, Washing-	Oil Shale Mining, Processing, Uses, and Envi-
Pavement Facilities,	ton,	ronmental Impacts, August, 1981-October, 1982: Citations from the NTIS Data Base.
W86-00098 2E	W86-00114 5C	W86-00215 5D
URBANIZATION	Availability of Water from the Alluvial Aquifer	
Planning and Implementation of Regional	in Part of the Green River Valley, King County,	New Concepts and Practices in Activated
Stormwater Management Facilities in Montgom-	Washington, W86-00126 2F	Sludge Process Control, W86-00221 5D
ery County, Maryland, W86-00099 4A		W 80-00221
	Suspended Particulate Matter in Elliott Bay, W86-00151 2J	Chemicals and Wetlands,
Water and the City, W86-00264 6D		W86-00233 5C
	WASTE DISPOSAL	Modeling of an ANFLOW Municipal Waste-
UTAH	Digital Simulation of the Regional Effects of Subsurface Injection of Liquid Waste near Pen-	Treatment Unit,
Trend Analysis of Salt Load and Evaluation of the Frequency of Water-Quality Measurements	sacola, Florida,	W86-00246 5D
for the Gunnison, the Colorado, and the Dolores	W86-00122 5B	Evaluation of the 'Lectro Clear Z' Electrocoa-
Rivers in Colorado and Utah,	Potential for Contamination of Shallow Aquifers	gulation Process for Meat Packing Wastewater
W86-00123 5B	in Illinois,	Treatment.
UTILITIES	W86-00178 5E	W86-00252 5D
Water Utility Operating Data: An Analysis,	WASTE LOAD	Annotated Bibliography on Northern Environ-
W86-00004 6D	Mixing Zone Model for Conservative Param-	mental Engineering, 1978-1979,
VARIABILITY	eters,	W86-00289 10C
Interannual Steamflow Variability in the United States Based on Principal Components,	W86-00089 5G	WATER ANALYSIS
W86-00076 2E	WASTEWATER COMPOSITION	Analysis of Phenols by Chemical Derivatization
	Development Document for Effluent Limita- tions Guidelines and Standards for the Textile	IV. Rapid and Sensitive Method for Analysis o
VARIANCE Minimum Variance Streamflow Record Aug-	Mills Point Source Category.	 Chlorophenols by Improved Chloroacetyla tion Procedure,
mentation Procedures,	W86-00207 5G	W86-00002 5A
W86-00079 2E	WASTEWATER MANAGEMENT	
VARIOGRAMS	Survey of National and State Regulatory	Microbiological Water Quality of Impound ments: A Literature Review,
Variogram Identification by the Mean-Squared	Agency Policy and Procedures for the Determi-	W86-00185 5A
Interpolation Error Method with Application to Hydrologic Fields.	nation of the Toxicity of Wastewater Effluents. W86-00211 6E	
W86-00024 2A	ALBERT A STATE OF THE STATE OF	Environmental Engineering, W86-00188 51
The state of the s	WASTEWATER OUTFALL	W 60-00166
VEGETATION Shore Stabilization with Salt Marsh Vegetation,	Seawater Circulation in Sewage Outfall Tunnels, W86-00017 5E	Karnes County, Texas, Area Hydrochemical and
W86-00189 8G		Stream Uranium Orientation Study, W86-00194 23
Long-Term Ecological Behaviour of Aban-	WASTEWATER REUSE	W 80-00194
doned Uranium Mill Tailings; 2.: Growth Pat-	Wastewater Reuse and Exposure to Legionella Organisms,	Procedures for Handling and Chemical Analysi
terns of Indigenous Vegetation on Terrestrial	W86-00054 5C	of Sediment and Water Samples, W86-00198
and Semi-Aquatic Areas,	WASTEWATED TOP ATMENT	W86-00198
W86-00217 5C	WASTEWATER TREATMENT Toxic Organics Removal Kinetics in Overland	Microcomputer Assisted Quality Assurance,
Impact of Water Level Changes on Woody Ri-	Flow Land Treatment,	W86-00203 5A
parian and Wetland Communities; Volume X:	W86-00057 5D	Guide to Stream Habitat Analysis Using th
Index and Addendum to Volumes I-VIII, W86-00254 21	Computer Simulation of an Industrial	Instream Flow Incremental Methodology,
TOTAL STATE OF THE	Wastewater Treatment Process,	W86-00251 60
Impact of Water Level Changes on Woody Ri- parian and Wetland Communities; Volume IX:	W86-00058 5D	Addendum to Handbook for Sampling an
The Alaska Region,	Chemistry for Operators,	Sample Preservation.
W86-00292 2I	W86-00134 5F	W86-00268 5/

WATER ANALYSIS. *WATER DISTRIBUTION

VATER ANALYSIS. *WATER DISTRIBUTION Sampling Frequency - Microbiological Drinking	WATER LEVEL FLUCTUATIONS Impact of Water Level Changes on Woody Ri-	Volunteer Lake Monitoring, 1981, W86-00200 5C
Water Regulations: Final Report,	parian and Wetland Communities; Volume X:	
W86-00245 5A	Index and Addendum to Volumes I-VIII, W86-00254 2I	Methods for Ecological Toxicology: A Critical Review of Laboratory Multispecies Tests.
VATER CONVEYANCE		W86-00210 5C
Optimal Urban Water Distribution Design,	Impact of Water Level Changes on Woody Ri-	Comment of Marianal and Chata Bamplatana
W86-00071 5F	parian and Wetland Communities; Volume IX: The Alaska Region,	Survey of National and State Regulatory Agency Policy and Procedures for the Determi-
WATER CURRENTS	W86-00292 2I	nation of the Toxicity of Wastewater Effluents.
Circulation in the Lower Cook Inlet, Alaska,	WATER MANAGEMENT	W86-00211 6E
W86-00149 2L	Opportunities to Protect Instream Flows in Alaska,	Long-Term Ecological Behaviour of Abandoned Uranium Mill Tailings; 2.: Growth Pat-
Preliminary User's Manual 3-D Mathematical Model of Coastal, Estuarine, and Lake Currents	W86-00280 6E	terns of Indigenous Vegetation on Terrestrial and Semi-Aquatic Areas,
(CELC3D),	WATER POLICY	W86-00217 5C
W86-00168 2E	Opportunities to Protect Instream Flows in	
Current Measurements in the Columbia River	Alaska, W86-00280 6E	Groundwater Management Strategy for Michi- gan: Economic and Social Impacts of Ground-
Estuary, W86-00181 2L	WATER POLLUTION	water Contamination; A Case Study in East Bay
W80-00181 2L	Laboratory Protocols for Evaluating the Fate of	Township, Grand Traverse County, Michigan. W86-00218 5C
Norfolk Harbor and Channels Deepening Study, Report 1: Physical Model Results, Chesapeake	Organic Chemicals in Air and Water, W86-00154 5A	
Bay Hydraulic Model Investigation,	W 80-00134	Working Papers Prepared as Background for
W86-00266 2L	WATER POLLUTION CONTROL Preliminary Evaluation of Lake Susceptibility to	Testing for Effects of Chemicals on Ecosystems. W86-00230 5C
WATER DEMAND	Water-Quality Degradation by Recreational	Lakes and Microcosms: Extending Microcosm
Public Water Supplies in Gloucester County,	Use, Alpine Lakes Wilderness Area, Washing-	Data to Aquatic Ecosystems,
NJ.,	ton,	W86-00231 5C
W86-00174 2F	W86-00114 5C	
Present and Prospective Use of Water by the	Oil Shale Mining, Processing, Uses, and Envi- ronmental Impacts, 1978-July, 1981: Citations	Optimum Microcosms for Lake Ecotoxicology, W86-00232 5C
Manufacturing Industries of New Jersey, W86-00175 6D	from the NTIS Data Base.	Ecotoxicology at the Watershed Level,
	W86-00201 4C	W86-00234 5B
Water and the City, W86-00264 6D	Restoration of Habitats Impacted by Oil Spills. W86-00239 5C	Utility of Single Species and Ecosystem Tests in Assessing the Environmental Impact of Radio-
Modeling Water Demands.		nuclide Ecotoxicants,
W86-00270 6D	Winter Evaluation of Oil Skimmers and Booms. W86-00290 5G	W86-00235 5B
Water Demand,	WATER BOLL WILDLIAM CONTROL WEATER	Classes of Ecotoxicological Tests: Their Advan-
W86-00271 6D	WATER POLLUTION CONTROL. *WATER QUALITY CONTROL	tages and Disadvantages for Regulation, W86-00236 5C
Methodological Framework,	Oil Shale Mining, Processing, Uses, and Envi-	W 00-00230
W86-00272 6D	ronmental Impacts, August, 1981-October, 1982: Citations from the NTIS Data Base.	Ecosystem Approach to the Toxicology of Resi- due Forming Xenobiotic Organic Substances in
Industrial Water Demands,	W86-00215 5D	the Great Lakes,
W86-00273 6D	WATER POLLUTION EFFECTS	W86-00237 5B
	Rapidity of RNA Synthesis in Human Cells; A	
Agricultural Water Demands,	Highly Sensitive Parameter for Water Cytotoxi-	Restoration of Habitats Impacted by Oil Spills. W86-00239 5C
W86-00274 6D	city Evaluation,	W86-00239 5C
Municipal Water Demands,	W86-00052 5A	Recovery and Restoration of Rocky Shores,
W86-00275 6D	Toxicity to Daphnia of the End Products of Wet	Sandy Beaches, Tidal Flats, and Shallow Subti- dal Bottoms Impacted by Oil Spills,
Programming Models for Regional Water	Oxidation of Phenol and Substituted Phenols, W86-00064 5D	W86-00240 5C
Demand Analysis, W86-00276 6D	Digital Simulation of the Regional Effects of	Effects of Oil on Seagrass Ecosystems,
	Subsurface Injection of Liquid Waste near Pen-	W86-00241 5C
National Perspective in Water Demand Model- ing,	sacola, Florida, W86-00122 5B	Recovery and Restoration of Salt Marshes and
W86-00277 6D		Mangroves Following an Oil Spill, W86-00242 5C
WATER DISPOSAL	Economically Relevant Response Estimation and the Value of Information: Acid Deposition,	
Leachate from Hazardous Wastes Sites,	W86-00139 6B	Measurements of Damage, Recovery, and Reha-
W86-00247 5E	Economic Impact of Acid Precipitation: A Ca-	bilitation of Coral Reefs Exposed to Oil, W86-00243 5C
WATER DISTRIBUTION	nadian Perspective,	Fisheries Resource Impacts from Spills of Oil or
Environmental Engineering,	W86-00142 6C	Hazardous Substances.
W86-00188 5F	Legal, Ethical, Economic and Political Aspects	W86-00244 5C
WATER LAW	of Transfrontier Pollution,	Effects, Pathways, Processes, and Transforma-
Environmental Engineering,	W86-00143 6E	tion of Puget Sound Contaminants of Concern,
W86-00188 5E	Acidification impact on risheries: Substitution	W86-00293 5B
Opportunities to Protect Instream Flows in	and the Valuation of Recreation Resources, W86-00144 5G	Ethylene: Environmental and Technical Infor-
Alaska,		mation for Problem Spills.
W86-00280 6B	Long-Term Impact of Dredged Material at Two Open-Water Sites: Lake Erie and Elliot Bay;	W86-00303 5C
WATER LEVEL	Evaluative Summary	WATER POLLUTION PREVENTION
Review of the Effects of Water-Level Change on Reservoir Fisheries and Recommendation	8 W86-00160 5C	Sorption Behaviour of 14C in Groundwater/ Rock and in Groundwater/Concrete Environ-
for Improved Management,	Environmental Engineering,	ments,
W86-00158 60		W86-00184 . 5B

. 5B

Modification of Bell Canyon Test (BCT) 1-FF Grout,	WATER QUALITY Rainwater Catchment Water Quality in Micro-	Stream Water Quality in the Coal Region of Ohio,
W86-00248 8G	nesia,	W86-00267 5B
Ethylene: Environmental and Technical Information for Problem Spills.	W86-00061 3B Some Recent Adaptations and Applications of	Stream Water Quality in the Coal Region of Pennsylvania,
W86-00303 5C	QUAL-II in the Northeast,	W86-00281 5B
WATER POLLUTION SOURCES	W86-00090 5B	WATER QUALITY CONTROL
Point Sources-Nonpoint Sources Trading in the		Economic Perspectives on Acid Deposition
Lake Dillon Watershed. W86-00167 5B	West-Central New Mexico, W86-00108 2F	Control. W86-00136 5G
Environmental Engineering,	Hydrogeologic and Water-Quality Characteris-	Acid Rain: Does Science Dictate Policy or
W86-00188 5F	tics of the Mount Simon-Hinckley Aquifer, Southeast Minnesota.	Policy Dictate Science, W86-00137 6E
Development Document for Effluent Limita- tions Guidelines and Standards for the Textile		
Mills Point Source Category.	Quality of Water, Quillayute River Basin, Wash-	Effect of Global Optimization on Locally Opti- mal Pollution Control: Acid Rain,
W86-00207 5G		W86-00138 6C
Leachate from Hazardous Wastes Sites,	W86-00111 2K	Scientific Truths and Policy Truths in Acid
W86-00247 5E		Deposition Research,
Stream Water Quality in the Coal Region of	Water-Quality Degradation by Recreational Use, Alpine Lakes Wilderness Area, Washing-	W86-00140 6B
Alabama and Georgia,	ton.	Transferable Discharge Permits and Profit-
W86-00250 5E	W86-00114 5C	Maximizing Behavior, W86-00145 5G
Stream Water Quality in the Coal Region o	Water Resources Data for Profita, Water Tear	
West Virginia and Maryland, W86-00253 5E	1981 Volume 1: Northeast Florida. W86-00127 7C	Oil Shale Mining, Processing, Uses, and Envi- ronmental Impacts, 1978-July, 1981: Citations
Planning Guide for Evaluating Agricultura	Water Resources Data for Colorado, Water	from the NTIS Data Base.
Nonpoint Source Water Quality Controls, W86-00260 50	Year 1982, Volume 2. Colorado River Basin	W86-00201 4C
	Was cours River,	Development Document for Effluent Limita- tions Guidelines and Standards for the Textile
Stream Water Quality in the Coal Region of Ohio,	the second secon	Mills Point Source Category.
W86-00267 51	Water Resources Data, North Dakota, Water Year 1981, Volume 1. Hudson Bay Basin.	W86-00207 5G
Stream Water Quality in the Coal Region of	11/06 00120	Technique to Optimally Locate Multilevel In-
Pennsylvania, W86-00281 51	Water Resources Data Hawaii, Other Pacific	takes for Selective Withdrawal Structures, W86-00213
	Areas, Water Year 1981. Volume 2. Guam,	Modification of Bell Canyon Test (BCT) 1-FF
Survey of Polychlorinated Biphenyls in Industr- al Effluents in Canada.	Micronesia, Palau Islands and American Samoa.	Grout,
W86-00286 5	B W86-00130 7C	W86-00248 8G
European and United States Case Studies i Application of the CREAMS Model.	n Dissolved Methane Concentrations in the South- east Bering Sea, 1980 and 1981,	Planning Guide for Evaluating Agricultural Nonpoint Source Water Quality Controls,
W86-00294 5	B W86-00180 2K	W86-00260 5G
CREAMS: A System for Evaluating Manage	Microbiological Water Quality of Impound-	
ment Practices on Field-Size Areas,	ments: A Literature Review, W86-00185 5A	W86-00290 5G
W86-00295	A second of the	European and United States Case Studies in
Testing the Application of CREAMS to Finnis Conditions,	th User Guide for LARM2: A Longitudinal-Verti- cal, Time-Varying Hydrodynamic Reservoir	
	B Model,	
Environmental Effects of Nitrogen Fertilization	W86-00190 5B	CREAMS: A System for Evaluating Manage- ment Practices on Field-Size Areas,
Exemplified by Groundwater Pollution as Sim-	Volunteer Lake Monitoring, 1981,	W86-00295 5B
lated by CREAMS,	W86-00200 5C	Testing the Application of CREAMS to Finnish
And the said that the said the	B Phytoplankton-Environmental Interactions in	Conditions,
Application of the CREAMS Model for Calc lation of Leaching of Nitrate from Light Soils		W86-00296 5B
the Notec River Valley,	W86-00206 2H	
W86-00298	B Groundwater Management Strategy for Michi-	Exemplified by Groundwater Pollution as Simulated by CREAMS,
Application of the CREAMS Model: Weste	rn gan: Economic and Social Impacts of Ground-	W86-00297 5B
Skane, Sweden, W86-00299	water Contamination; A Case Study in East Bay Township, Grand Traverse County, Michigan	
	W86-00218 5C	lation of Leaching of Nitrate from Light Soils in
Predicting Hillslope Runoff and Erosion in t United Kingdom: Preliminary Trials with t		the Notec River Valley, W86-00298 5B
CREAMS Model,	Alabama and Georgia,	
	5B W86-00250 5E	Skane, Sweden,
Application of the CREAMS Model as Part		
an Overall System for Optimizing Environme tal Management in Lithuania, USSR: First E		
periments, W86-00301	Mathematical Model, SERATRA, for Sediment	United Kingdom: Preliminary Trials with the CREAMS Model.
	Contaminant Transport in Rivers and Its Appli	- W86-00300 5B
Review of Case Studies of CREAMS Mod Application,	del cation to Pesticide Transport in Four Mile and Wolf Creeks in Iowa.	Application of the CREAMS Model as Part of
	5B W86-00259 5I	

tal Management in Lithuania, USSR: First Exage of the Sulphur Creek Basin, Yakima County, WATERWAYS

WATER QUALITY CONTROL

W86-00301 5B	W86-00112 2J	pi River: River Mile 480-530; Report 3: Benthic
Review of Case Studies of CREAMS Model	WATER TREATMENT	Macroinvertebrate Studies Pilot Report,
Application,	Advantages of Dissolved-Air Flotation for	W86-00212 6G
W86-00302 5B	Water Treatment, W86-00005 5F	Channel Widths in Bends and Straight Reaches
WATER-QUALITY DATA		Between Bends for Push Towing: Hydraulic
Trend Analysis of Salt Load and Evaluation of	Removing Barium and Radium Through Calci-	Model Investigation, W86-00225 8B
the Frequency of Water-Quality Measurements for the Gunnison, the Colorado, and the Dolores	um Cation Exchange, W86-00008 5F	
Rivers in Colorado and Utah,		Aquatic Habitat Studies on the Lower Mississip-
W86-00123 5B	In-Home Treatment Methods for Removing	pi River: River Mile 480-530; Report 6: Larval Fish Studies Pilot Report,
WATER QUALITY MANAGEMENT	Volatile Organic Chemicals, W86-00010 5F	W86-00226 6G
Review of Model Use in Evaluating Nonpoint		
Source Loads from Forest Management Activi-	Removal by Coagulation of Trace Organics from Mississippi River Water,	WAVE ACTION
ties, W86-00091 5B	W86-00011 5F	Wave Stability Study of Riprap-Filled Cells: Hydraulic Model Investigation,
W86-00091 5B		W86-00283 8A
Planning and Implementation of Regional	Inactivation of Naegleria gruberi Cysts by Chlo- rine Dioxide,	
Stormwater Management Facilities in Montgom- ery County, Maryland,	W86-00066 5F	WAVES
W86-00099 4A	Postero and Postero de	Cleveland Harbor, Ohio: Design for the Safe and Efficient Passage of 1,000-ft-Long Vessels at
	Environmental Engineering, W86-00188 5F	the West (Main) Entrance, Hydraulic Model In-
WATER QUALITY MANAGMENT Mixing Zone Model for Conservative Param-		vestigation,
eters.	Annotated Bibliography on Northern Environ-	W86-00204 8A
W86-00089 5G	mental Engineering, 1978-1979, W86-00289 10C	Mission Bay Harbor, California, Design for
WATER QUALITY STANDARDS		Wave and Surge Protection and Flood Control:
Mixing Zone Model for Conservative Param-	WATER USE	Hydraulic Model Investigation,
eters,	Public Water Supplies in Gloucester County, N.J.,	W86-00255 8B
W86-00089 5G	W86-00174 2F	Edgewater Marina, Cleveland, Ohio: Design for
WATER QUANTITY	Possest and Proposition Upon of Water has the	Wave Protection, Hydraulic Model Investiga-
Assessment of Water Resources in Lead-Zinc	Present and Prospective Use of Water by the Manufacturing Industries of New Jersey,	tion,
Mined Areas in Cherokee County, Kansas, and	W86-00175 6D	W86-00256 8B
Adjacent Areas, W86-00121 5A	Madeline Water Demands	Wave Data Acquisition and Hindcast for Sagi-
	Modeling Water Demands. W86-00270 6D	naw Bay, Michigan,
WATER SAMPLING Addendum to Handbook for Sampling and		W86-00282 2H
Sample Preservation.	Water Demand, W86-00271 6D	WEATHER DATA COLLECTIONS
W86-00268 5A	W80-002/1	Statistical Analysis of Precipitation Frequency
WATER SUPPLY	Methodological Framework,	in the Conterminous United States, Including
Public Water Supplies in Gloucester County,	W86-00272 6D	Comparisons with Precipitation Totals,
N.J.,	Industrial Water Demands,	W86-00020 2B
W86-00174 2F	W86-00273 6D	WEATHER FORECASTING
Environmental Engineering,	Agricultural Water Demands,	Outline of Severe Local Storms with the Mor-
W86-00188 5F	W86-00274 6D	phology of Associated Radar Echoes,
Groundwater Management Strategy for Michi-	Municipal Water Demands,	W86-00146 2B
gan: Economic and Social Impacts of Ground-	W86-00275 6D	WEATHER MODIFICATION
water Contamination; A Case Study in East Bay	Processing Models for Regional Water	SCPP Data Collection and Analysis for the
Township, Grand Traverse County, Michigan. W86-00218 5C	Programming Models for Regional Water Demand Analysis,	Period 1 September 1981 through 31 August
	W86-00276 6D	1982, W86-00216 2B
WATER SUPPLY DEVELOPMENT Uses of Recharge Wells in Water Supply,	National Perspective in Water Demand Model-	W86-00216 2B
W86-00006 4B	ing,	Ground-Base Snow and Ice Crystal Observation
	W86-00277 6D	System Used in Sierra Nevada Winter Orogra-
Application of the STORM Model to Design Problems in Singapore and in Kaosiung, Repub-	WATERSHED MANAGEMENT	phic Storms, W86-00222 2B
lic of China,	Mechanistic Simulation for Transport of Non-	11 00-00222
W86-00086 6A	point Source Pollutants,	Cloud Physics Studies in the SCPP: Interim
WATER SURFACE	W86-00092 5B	Progress Report, 1983-84.
Water Surface at Change of Channel Curvature,	Data Management for Continuous Hydrologic	W86-00305 3B
W86-00019 8B	Simulation,	Structure of Cold Fronts Over California,
WATER TABLE	W86-00093 2A	W86-00306 3B
Water Table in Rocks of Cenozoic and Paleozo-	Planning and Implementation of Regional	Responses to Seeding Clouds with Dry Ice in
ic Age, 1980, Yucca Flat, Nevada Test Site,	Stormwater Management Facilities in Montgom-	the SCPP-1 Experiment,
Nevada, W86-00116 2F	ery County, Maryland, W86-00099 4A	W86-00307 3B
		WEATHED DATTEDNO
WATER TABLE DECLINE	ANSWERS (Areal Nonpoint Source Watershed	WEATHER PATTERNS Atchafalaya River Delta; Report 9: Wind Clima-
Ground-Water Conditions in the Cottonwood- West Oakley Fan Area, South-Central Idaho,	Environment Response Simulation) User's Manual.	tology,
W86-00117 2F	W86-00287 4D	W86-00163 2L
WATER TEMPERATURE		Marine Weather of the Inland Waters of West-
Sediment Transport by Irrigation Return Flows	WATERSHEDS Hydrological Yearbook: 1980.	ern Washington,
in Four Small Drains Within the DID-18 Drain-	W86-00182 2A	W86-00165 2B

el Changes on Woody Ri-		ped with Linearly	Hydraulics of a Well Pur		WEED CONTROL
Communities; Volume IX			Decreasing Discharge,	ology for Chemical Control of	
	The Alaska Region,	2F	W86-00040		Aquatic Plants,
21	W86-00292			4A	W86-00183
			WEST GERMANY	h Annual Meeting, Aquatic	Decondings 16th Arm
	WILDERNESS LAKES	toplankton in Lake	Seasonal Succession of Ph	earch Planning and Operations	
n of Lake Susceptibility to			Constance,	search Flaming and Operations	Review.
adation by Recreational		2H	W86-00051	4A	W86-00192
ilderness Area, Washing-				***	***************************************
	ton,		WET OXIDATION	rations Management Test of	Large-Scale Operations
50	W86-00114		Toxicity to Daphnia of the	Amur for Control of Problem	Use of the White Amur f
		ubstituted Phenols,	Oxidation of Phenol and	Life History Information of	Plants: Selected Life H
	WILDLIFE	5D	W86-00064	n Lake Conway, FL,	Animal Species on Lake C
ons Management Test of			******	4A	W86-00197
ur for Control of Problem			WETLANDS		
Herpetofauna of Lake			Nitrogen and Phosphorus S	rations Management Test of	
	Conway, Species Accord		a Large Florida River Wetl	Amur for Control of Problem	
60	W86-00202	2H	W86-00080	The Herpetofauna of Lake Accounts,	Conway, Species Accoun
	WIND	e Washington and	Historical Changes to La	6G	W86-00202
lta; Report 9: Wind Clima	Atchafalaya River Delt	on Ship Canal, King	Route of the Lake Washing		
	tology,		County, Washington,	Concentrations for Control of	
21	W86-00163	2H	W86-00105	ilfoil and Sago Pondweed,	
				4A	W86-00208
	ZINC		Chemicals and Wetlands,		WELL YIELD
ulation (Cd, Cu, Pb and		5C	W86-00233	ater from the Alluvial Aquifer	
nerus mordax) From the				en River Valley, King County,	
Lawrence Estuary (Accu			Impact of Water Level Ch	,,,,	Washington,
Metaux Lourds (Cd, Cu			parian and Wetland Com	2F	W86-00126
Sperlan (Osmerus mordax			Index and Addendum to V		
Nord De L'Estuaire de		21	W86-00254		WELLS
	Saint-Laurent),				Uses of Recharge Wells in
50	W86-00059			4B	W86-00006

acoust Water Commission Visions		
The Alash Region		
ASSESSED SERVING TO A		Plant Committee of the Standard Committee of the Plant
Principles E single of take Suggestaling	340200	
Water-Quality Day and beer my Mercadies	ME THE THE THE THE THE THE THE THE THE TH	
	WE TEN BUTTON	
N DX 30W	and the same of the same of the same of the same of	and the state of t
	the second of the second of the second	to the state of th
	many report of the control of	to the second state of the second
		and in manager and large control
		0.00.419
	the second of th	
Andrew Street, Revenue Ward Con-	print have men an entire and to the a	The State of the State of Stat
	at tentoty	
	2,000 12.11	
		compared to the second transfer of the state of the
		the property and a fine the first of the first
	Property and the second by the self-	The state of the s
or determinant on the model of the second of		10 (0.00)
	DIVERSION OF THE PARTY OF THE PARTY.	
	to the first that the same of	
	41.0	
	The state of the s	
	alleria and a second at	
		the notation of the
		The state of the s
14	- " · · · · · · · · · · · · · · · · · ·	
	- at a state	all
	the state of the s	101-141
	The second of the second	
	1. 1. X. A. H.	
	kan ya wall a mile	The state of the s
and the same of th		For an IIII to an III
	X1401	
	11121	
	to be senior in the	a martin of a grant by a se
	the state of the s	and the second second
A		
	(1-1)	44
	Tark late	
	and the section of the	2 1. milital
	1.4	
	21.96	over the second state of the second
		wind and of print to ansert
2 4 4 4 4 4	17 14 17	
	the war all a place to be at high	
	and the transport of the transport	
		riga CTV - In
		144 2701
	The second second	THE STATE OF THE S
	A THE PART OF THE PARTY OF THE	L DIVINE RESERVED OF COMME
	the first of the second second	ed may many warms in a
		The second second
	1	
	1.74 114	the stay I stay
	10-6	all the second of the second of the second
	1 3 1 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
	1 45 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	

AUTHOR INDEX

ACUFF, H. F. Edgewater Marina, Cleveland, Ohio: Design for	ASHLEY, K. I. Hypolimnetic Aeration: Practical Design and	BERCOVIER, H. Wastewater Reuse and Exposure to Legionella
Wave Protection, Hydraulic Model Investiga- tion,	Application, W86-00060 5G	Organisms, W86-00054 5C
W86-00256 8B	ATKINSON, S.	BERG, R. C.
ADAMS, R. M. Economically Relevant Response Estimation and the Value of Information: Acid Deposition, W86-00139 6B	Effect of Global Optimization on Locally Optimal Pollution Control: Acid Rain, W86-00138 6C	Potential for Contamination of Shallow Aquifers in Illinois, W86-00178 5E
ADOLPHSON, D. G. Hydrogeologic and Water-Quality Characteristics of the Mount Simon-Hinckley Aquifer, Southeast Minnesota, W86-00109 2K	AUBLE, G. T. Results of an Adaptive Environmental Assessment Modeling Workshop- Concerning Potential Impacts of Drilling Muds and Cuttings on the Marine Environment, W86-00147 5C	BERG, V. H. Planning and Implementation of Regional Stormwater Management Facilities in Montgom- ery County, Maryland, W86-00099 4A
AGOSTINELLI, V. M. Program Criteria Specifications Document: Computer Program TWDA for Design and Analysis of Inverted-T Retaining Walls and Floodwalls, W86-00193	AYERS, K. Removal by Coagulation of Trace Organics from Mississippi River Water, W86-00011 5F BADJI, M.	BINGHAM, C. R. Aquatic Habitat Studies on the Lower Mississippi River: River Mile 480.530; Report 3: Benthic Macroinvertebrate Studies Pilot Report, W86-00212 6G
ALAERTS, M. Comparing the Performance of Root-Water-Uptake Models, W86-00048 2D	Comparing the Performance of Root-Water- Uptake Models, W86-00048 2D BAILLOD, C. R.	BLATTNER, J. L. Water Resources Data for Colorado, Water Year 1982, Volume 2. Colorado River Basin above Dolores River, W86-00128 7C
ALDRED, M. L. Multiresidue Method for the Analysis and Verification of Several Herbicides in Water, W86-00046 5A	Toxicity to Daphnia of the End Products of Wet Oxidation of Phenol and Substituted Phenols, W86-00064 5D BAKER, E. T.	BOMBERGER, D. C. Laboratory Protocols for Evaluating the Fate of Organic Chemicals in Air and Water,
ALLARD, B. Sorption Behaviour of 14C in Groundwater/	Suspended Particulate Matter in Elliott Bay, W86-00151 2J	W86-00154 5A BOND, C. L.
Rock and in Groundwater/Concrete Environ- ments, W86-00184 5B	BAKER, J. A. Block-Geometry Functions Characterizing Transport in Densely Fissured Media,	Fishes of Selected Aquatic Habitats on the Lower Mississippi River, W86-00195 6G
ALLEN, H. E. JR. Runoff, Sediment Transport, and Water Quality in a Northern Illinois Agricultural Watershed before Urban Development, 1979-81, W86-00133 2J	W86-00039 Fishes of Selected Aquatic Habitats on the Lower Mississippi River, W86-00195 6G	BONING, C. W. Streamflow Losses Along the Balcones Fault Zone, Nueces River Basin, Texas, W86-00124 2E
ALLEN, R. SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August 1982.	BANCROFT, G. T. Large-Scale Operations Management Test of Use of the White Amur for Control of Problem Aquatic Plants: The Herpetofauna of Lake Conway, Species Accounts,	BOTTIN, R. R. Barcelona Harbor, New York, Design for Harbor Improvements: Hydraulic Model Inves- tigation, W86-00157
W86-00216 2B ALVORD, R. C.	W86-00202 6G	Buhne Point, Humboldt Bay, California, Design
Availability of Water from the Alluvial Aquifer in Part of the Green River Valley, King County, Washington,	BANERJI, S. Monitoring of Reservoir Volume Using Landsat Data, W86-00032 7C	for the Prevention of Shoreline Erosion: Hy- draulic and Numerical Model Investigations, W86-00169 4D
W86-00126 2F ANDERSSON, K. Sorption Behaviour of 14C in Groundwater/	BARNES, S. SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August	Cleveland Harbor, Ohio: Design for the Safe and Efficient Passage of 1,000-ft-Long Vessels at the West (Main) Entrance, Hydraulic Model In-
Rock and in Groundwater/Concrete Environ- ments,	1982, W86-00216 2B	vestigation, W86-00204 8A
W86-00184 5B ANDREWS, A. K.	BARNETT, T. P. Foundations of Principal Component Selection	Edgewater Marina, Cleveland, Ohio: Design for Wave Protection, Hydraulic Model Investiga-
Results of an Adaptive Environmental Assessment Modeling Workshop Concerning Poten-	Rules, W86-00186 7C	tion, W86-00256
tial Impacts of Drilling Muds and Cuttings on the Marine Environment, W86-00147	BASTIN, G. Variogram Identification by the Mean-Squared Interpolation Error Method with Application to	BOUCHER, P. R. Sediment Transport by Irrigation Return Flows in Four Small Drains Within the DID-18 Drain-
ARMSTRONG, B. C. Annotated Bibliography on Northern Environmental Engineering, 1978-1979,	Hydrologic Fields, W86-00024 2A	age of the Sulphur Creek Basin, Yakima County, Washington, April 1979 to October 1981, W86-00112
W86-00289 10C	BAXTER, K. M. Effects on Groundwater Quality of the Intro-	
ARNAC, M. Heavy Metal Accumulation (Cd, Cu, Pb and Zn) by Smelt (Osmerus mordax) From the North Shore of the St Lawrence Estuary (Accu- mulation de Quelques Metaux Lourds (Cd, Cu,	duction of Secondary Sewage Treatment to an Effluent Recharge Site on the Chalk of Southern England, W86-00043	BOVEE, K. D. Guide to Stream Habitat Analysis Using the Instream Flow Incremental Methodology, W86-00251 6G
Po Et Za) Chez L'Eperian (Comerus mordax) Preleve Sur La Rive Nord De L'Estuaire du Saint-Laurent), W86-00059 5C	BELANGER, T. V. Groundwater Seepage Nutrient Loading in a Florida Lake, W86-00065 2H	BOWER, B. T. Water Demand, W86-0211 6D
ARTHUR, R. M. New Concepts and Practices in Activated	BENGTSSON, L. Snowmelt Induced Urban Runoff in Northern Sweden.	BRANNON, J. M. Characterization of Aerobic Chemical Processes in Reservoirs: Problem Description and Model Exemplation
Sludge Process Control, W86-00221 5D	W86-00097 2C	Formulation, W86-00176 5E

J.S. SASE

BRAS, R. L. Spatially Varying Rainfall and Floodrisk Analysis,	CESSNA, A. J. Multiresidue Method for the Analysis and Verification of Several Herbicides in Water,	Hydrocarbons Associated with Suspended Matter in the Green River, Washington, W86-00196 5B
W86-00012 2E BRASS, H. J.	W86-00046 5A CHAPMAN, P. M.	COBB, S. P. Aquatic Habitat Studies on the Lower Mississip-
In-Home Treatment Methods for Removing Volatile Organic Chemicals, W86-00010 5F	Effects, Pathways, Processes, and Transforma- tion of Puget Sound Contaminants of Concern, W86-00293 5B	pi River: River Mile 480-530; Report 3: Benthic Macroinvertebrate Studies Pilot Report, W86-00212 6G
BRENDECKE, C. M. Comparison of Two Daily Streamflow Simulation Models of an Alpine Watershed, W86-00033 2E	CHAPMAN, R. J. Impact of Water Level Changes on Woody Riparian and Wetland Communities; Volume X: Index and Addendum to Volumes I-VIII,	COHN, T. A. Condensed Disaggregation Model for Incorporating Parameter Uncertainty Into Mouthly Reservoir Simulations.
BRICE, J. C. Stream Channel Stability Assessment,	W86-00254 2I	W86-00073 2E
W86-00214 2J BRIGHT, T. J. Measurements of Damage, Recovery, and Rehabilitation of Coral Reefs Exposed to Oil,	CHAU, A. S. Y. Analysis of Phenols by Chemical Derivatization. IV. Rapid and Sensitive Method for Analysis of 21 Chlorophenols by Improved Chloroacetyla- tion Procedure.	COLLINS, C. D. Coefficients for Use in the U.S. Army Corps of Engineers Reservoir Model, CE-QUAL-R1, W86-00153 5B
W86-00243 5C	W86-00002 5A	COPELAND, R. R.
BROCARD, D. N. Surface Buoyant Jets in Steady and Reversing Crossflows,	CHAUHAN, H. S. Hydraulics of a Well Pumped with Linearly Decreasing Discharge,	MeGee Creek Pumping Station Siphon, Pike County, Illinois: Hydraulic Model Investigation, W86-00219
W86-00014 5B BROWN, W. E.	W86-00040 2F CHEN, C. Y.	Pointe Coupee Pumping Station Sump and Outlet Structure, Upper Pointe Coupee Loop
Hydraulics for Operators, W86-00135 8B	Unified Theory for Microbial Growth under Multiple Nutrient Limitation,	Area, Louisiana: Hydraulic Model Investigation, W86-00101
BRUCKNER, L. M.	W86-00067 2H	CORBET, R. L. Laboratory and Field Studies on the Fate of
Planning Guide for Evaluating Agricultural Nonpoint Source Water Quality Controls, W86-00260 5G	CHEN, R. L. Characterization of Aerobic Chemical Processes in Reservoirs: Problem Description and Model	1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and Sediments, W86-00047 5B
BUCHAK, E. M. User Guide for LARM2: A Longitudinal-Verti- cal, Time-Varying Hydrodynamic Reservoir	Formulation, W86-00176 5B CHEN, Y. S. R.	CORDOVA, J. R. Probabilistic Structure of Storm Surface Runoff,
Model, W86-00190 5B	Inactivation of Naegleria gruberi Cysts by Chlo- rine Dioxide,	W86-00083 2E
BUCK, A. D. Modification of Bell Canyon Test (BCT) 1-FF Grout,	W86-00066 5F CHEREMISINOFF, P. N.	CORNEAU, G. M. Assessment of Heavy Metals and PCB's at Selected Studge Application Sites in Ontario, W86-00102 5A
W86-00248 8G	Leachate from Hazardous Wastes Sites, W86-00247 5B	CORRADINI, C.
BUCKLEY, J. Fate of Chemically Dispersed Oil in the Sea: A Report on Two Field Experiments, W86-00172 5B	CHOU, TW. Laboratory Protocols for Evaluating the Fate of Organic Chemicals in Air and Water,	Analysis of the Effects of Orography on Surface Rainfall by a Parameterized Numerical Model, W86-00023
BUELL, G. R.	W86-00154 5A	CROCKER, T. D.
Preliminary Appraisal of Sediment Sources and Transport in Kings Bay and Vicinity, Georgia and Florida, W86-00125	CHRISTENSEN, E. R. Unified Theory for Microbial Growth under Multiple Nutrient Limitation, W86-00067 2H	Economically Relevant Response Estimation and the Value of Information: Acid Deposition W86-00139 6E
BUGLEWICZ, E. G.	CHRISTIAN, R. R.	Scientific Truths and Policy Truths in Acid Deposition Research,
Large-Scale Operations Management Test of Use of the White Amur for Control of Problem	Sampling Frequency - Microbiological Drinking Water Regulations: Final Report,	W86-00140 6E
Plants: Selected Life History Information of Animal Species on Lake Conway, FL,	W86-00245 5A	CROUSE, J. M. Planning and Implementation of Regiona
W86-00197 4A	CHRZASTOWSKI, M. J. Historical Changes to Lake Washington and	Stormwater Management Facilities in Montgom ery County, Maryland,
BURKES, J. P. Modification of Bell Canyon Test (BCT) 1-FF Grout,	Route of the Lake Washington Ship Canal, King County, Washington,	W86-00099 4A
W86-00248 8G	W86-00105 2H	Mission Bay Harbor, California, Design fo
BURTON, G. A. Microbiological Water Quality of Impoundments: A Literature Review,	CHUGH, A. K. Seepage Analysis Using the Boundary Element Method, W86-00228 2G	Wave and Surge Protection and Flood Control Hydraulic Model Investigation, W86-00255
W86-00185 5A	CHURCHILL, P. A.	D'ARGE, R. C. Legal, Ethical, Economic and Political Aspect
BYRNE, H. M. STREX TOVS/Radiosonde Comparison, Part I: TOVS/AVHRR and Radiosonde Inventory, W86-00187	Groundwater Seepage Nutrient Loading in a Florida Lake,	of Transfrontier Pollution, W86-00143 6I
W86-00187 7B	CINTRON, G.	DALY, E. M. In-Home Treatment Methods for Removing
Normative Economics and the Acid Rain Prob- lem,	Recovery and Restoration of Salt Marshes and Mangroves Following an Oil Spill,	Volatile Organic Chemicals, W86-00010 51
W86-00141 6B		DANGLOT, C. Rapidity of RNA Synthesis in Human Cells;
CARTWRIGHT, K. Potential for Contamination of Shallow Aquifers in Illinois, W86-00178 5E	Dissolved Methane Concentrations in the South- east Bering Sea, 1980 and 1981,	Highly Sensitive Parameter for Water Cytotox city Evaluation,
7.000170		

DATTA, B.	DORTCH, M. S.	EMMETT, L. F.
Nonlinear Time-Variant Constrained Model for	Technique to Optimally Locate Multilevel In-	Ground-Water Resources of Audrain County,
Rainfall-Runoff,	takes for Selective Withdrawal Structures,	Missouri,
W86-00022 2A	W86-00213 8A	W86-00113 2F
DAUS, A. D.	DOTY, G. C.	ENGLEHART, P. J.
Alternating Direction Galerkin Technique for	Water Table in Rocks of Cenozoic and Paleozo-	Statistical Analysis of Precipitation Frequency
Simulation of Contaminant Transport in Com- plex Groundwater Systems,	ic Age, 1980, Yucca Flat, Nevada Test Site,	in the Conterminous United States, Including
W86-00072 5B	Nevada,	Comparisons with Precipitation Totals,
	W86-00116 2F	W86-00020 2B
DAVIDSON, M. R. Numerical Calculation of Saturated-Unsaturated	DOUGLAS, A. V.	WITH A NIPO Y O
Infiltration in a Cracked Soil,	Statistical Analysis of Precipitation Frequency	EUBANKS, L. S.
W86-00078 2G	in the Conterminous United States, Including	Normative Economics and the Acid Rain Prob- lem,
	Comparisons with Precipitation Totals, W86-00020 2B	W86-00141 6B
DAVIS, W. P. Fisheries Resource Impacts from Spills of Oil or	W86-00020 2B	W 00 00141
Hazardous Substances.	DRACUP, J. A.	EYRE, P. R.
W86-00244 5C	Regional Frequency Analysis of Multiyear	Investigation of Waikele Well No. 2401-01,
DAWE, B, R,	Droughts Using Watershed and Climatic Infor- mation.	Oahu, Hawaii: Pumping Test, Well Logs and Water Quality,
Use of Satellite Imagery for Tracking the Kur-	W86-00025 2A	W86-00118 2K
distan Oil Spill,	11 00 00025	W 30-00110 2.K
W86-00291 7B	DROST, B. W.	FALTA, R. W.
DE MARE, L.	Availability of Water from the Alluvial Aquifer	Analysis and Interpretation of Single-Well
Municipal Water Demands,	in Part of the Green River Valley, King County, Washington,	Tracer Tests in Stratified Aquifers,
W86-00275 6D	W86-00126 2F	W86-00074 2F
DELFINO, J. J.		FALVEY, H. T.
Fate of Aldicarb, Aldicarb Sulfoxide, and Aldi-	DYER, K. L.	Seepage Analysis Using the Boundary Element
carb Sulfone in Floridan Groundwater,	Stream Water Quality in the Coal Region of	Method,
W86-00045 5B	Alabama and Georgia, W86-00250 5B	W86-00228 2G
DEMARE, L.	W 80-00230	PARAGO E
Application of the CREAMS Model: Western	Stream Water Quality in the Coal Region of	FARAGO, T.
Skane, Sweden,	Ohio,	Soil Moisture Content: Statistical Estimation of Its Probability Distribution,
W86-00299 5B	W86-00267 5B	W86-00021 2G
DERAI-COCHIN, M.	Stream Water Quality in the Coal Region of	***************************************
Wastewater Reuse and Exposure to Legionella	Pennsylvania,	FATTAH, Q. N.
Organisms,	W86-00281 5B	Dispersion in Anisotropic, Homogeneous,
W86-00054 5C	Stream Water Quality in the Coal Region of	Porous Media,
DETHIER, P.	West Virginia and Maryland,	W86-00015 2F
Preliminary Evaluation of Lake Susceptibility to	W86-00253 5B	FATTAL, B.
Water-Quality Degradation by Recreational		Wastewater Reuse and Exposure to Legionella
Use, Alpine Lakes Wilderness Area, Washing- ton.	EARICKSON, J. A. Buhne Point, Humboldt Bay, California, Design	Organisms,
W86-00114 5C	for the Prevention of Shoreline Erosion: Hy-	W86-00054 5C
	draulic and Numerical Model Investigations,	FAURIS, C.
DICKS, A. S. Locations and Areas of Ponds and Carolina	W86-00169 4D	Rapidity of RNA Synthesis in Human Cells; A
Bays at the Savannah River Plant,	PREDCOT P. D. A.	Highly Sensitive Parameter for Water Cytotoxi-
W86-00263 2H	EBERSOLE, B. A. Atchafalaya River Delta; Report 8: Numerical	city Evaluation,
DICKS, B.	Modeling of Hurricane-Induced Storm Surge,	W86-00052 5A
Recovery and Restoration of Salt Marshes and	W86-00164 2A	PPPT V B A
Mangroves Following an Oil Spill,		FEELY, R. A. Sources, Composition, and Transport of Sus
W86-00242 5C	Atchafalaya River Delta; Report 9: Wind Clima-	pended Particulate Matter in Lower Cook Inle
DIEBOLD, F. E.	tology, W86-00163 2L	and Northwestern Shelikof Strait, Alaska,
Computer Simulation of an Industrial	W 80-00103	W86-00150 2J
Wastewater Treatment Process,	EDINGER, J. E.	
W86-00058 5D	User Guide for LARM2: A Longitudinal-Verti-	FERGUSON, R. I. Runoff from Glacierized Mountains: A Mode
DILLAHA, T. A. III	cal, Time-Varying Hydrodynamic Reservoir Model,	for Annual Variation and Its Forecasting,
Rainwater Catchment Water Quality in Micro-	W86-00190 5B	W86-00077 2E
nesia,		
W86-00061 3B	EDWARDS, T. K.	FERRARA, R. A.
DINICOLA, R. S.	Ground-Water Conditions in the Cottonwood- West Oakley Fan Area, South-Central Idaho,	Sediment-Water Interface in Modeling Pesti
Trend Analysis of Salt Load and Evaluation of	W86-00117 2F	cides in Sedimentation Ponds, W86-00088 5E
the Frequency of Water-Quality Measurements		W86-00088 5E
for the Gunnison, the Colorado, and the Dolores	EGGERT, K. G.	FEYEN, J.
Rivers in Colorado and Utah, W86-00123 5B	Mechanistic Simulation for Transport of Non- point Source Pollutants,	Comparing the Performance of Root-Water
	W86-00092 5B	Uptake Models,
DITMARS, J. D.		W86-00048 2D
Sampling and Detection of Tagged Dredged Material.	ELDER, J. F.	FLETCHER, B. P.
W86-00288 5A	Nitrogen and Phosphorus Speciation and Flux in	Bloomington Spillway North Branch Potomac
	a Large Florida River Wetland System, W86-00080 2H	River Maryland and West Virginia: Hydraulie
DOLA, S. Flood Damage Alleviation in New Jersey,		Model Investigation,
W86-00173 6F	ELLISON, R. A.	W86-00285
	Results of an Adaptive Environmental Assess-	FLOR, T. H.
DONIGAN, A. S. Hydrological Simulation Program-FORTRAN	ment Modeling Workshop- Concerning Poten- tial Impacts of Drilling Muds and Cuttings on	Poststorm Reconnaissance of Tropical Storm
(HSPF): Users Manual for Release 8.0,	the Marine Environment,	Chris,
W86.00199 2A	W86-00147 5C	W86-00279 21

AUTHOR INDEX

FORSTER, B. A.

FORSTER, B. A.	GETTER, C. D.	GREBE, R.
Economic Impact of Acid Precipitation: A Canadian Perspective, W86-00142 6C	Recovery and Restoration of Salt Marshes and Mangroves Following an Oil Spill, W86-00242 5C	Outline of Severe Local Storms with the Morphology of Associated Radar Echoes, W86-00146 2B
FOSTER, G. R. CREAMS: A System for Evaluating Management Practices on Field-Size Areas,	GIGLIELLO, K. A. Leachate from Hazardous Wastes Sites, W86-00247 5B	GREEN, D. R. Fate of Chemically Dispersed Oil in the Sea: A Report on Two Field Experiments,
W86-00295 5B	GILLIOM, R. J.	W86-00172 5B
FOSTER, P. Tracer Applications of Ultra-Violet Absorption Measurements in Coastal Waters, W86-00056 2L	Preliminary Evaluation of Lake Susceptibility to Water-Quality Degradation by Recreational Use, Alpine Lakes Wilderness Area, Washing- ton,	GRIEB, T. M. Phytoplankton-Environmental Interactions in Reservoirs, Volume II: Discussion of Workshop Papers and Open Literature,
FOUFOULA-GEORGIOU, E.	W86-00114 5C	W86-00206 2H
Estimation of Missing Values in Monthly Rainfall Series, W86-00094 2B	GISH, W. B. Flatiron AGC Interim Controller-Volume IV, W86-00223 8C	GROSS, D. T. Large-Scale Operations Management Test of Use of the White Amur for Control of Problem
FOUNTAIN, R. L. Chemistry for Operators, W86-00134 5F	GLEICK, P. H. Lakes and Microcosms: Extending Microcosm Data to Aquatic Ecosystems,	Aquatic Plants: The Herpetofauna of Lake Conway, Species Accounts, W86-00202 6G
FRANCO, J. J. Channel Widths in Bends and Straight Reaches	W86-00231 5C	GROSSMAN, D. S. Spatially Varying Rainfall and Floodrisk Analy-
Between Bends for Push Towing: Hydraulic Model Investigation, W86-00225 8B	GLYNN, J. E. Discrete-Time Linear Cascade under Time Averaging,	sis, W86-00012 2E
	W86-00028 2A	GROSSMAN, M.
Navigation Conditions in Vicinity of Walter Bouldin Lock and Dam Coosa River Project: Hydraulic Model Investigation,	GODLEY, J. S. Large-Scale Operations Management Test of Use of the White Amur for Control of Problem	Present and Prospective Use of Water by the Manufacturing Industries of New Jersey, W86-00175 6D
W86-00171 8A	Aquatic Plants: The Herpetofauna of Lake	GROVER, R.
FRERE, M. H. CREAMS: A System for Evaluating Manage-	Conway, Species Accounts, W86-00202 6G	Multiresidue Method for the Analysis and Veri- fication of Several Herbicides in Water,
ment Practices on Field-Size Areas, W86-00295 5B	GOFORTH, G. F.	W86-00046 5A
FRETWELL, M. O. Quality of Water, Quillayute River Basin, Wash-	Advancement in Hydraulic Modeling of Porous Pavement Facilities, W86-00098 2E	GUNNISON, D. Characterization of Aerobic Chemical Processes in Reservoirs: Problem Description and Model
ington, W86-00111 2K	GOLUBEV, G.	Formulation, W86-00176 5B
FRIND, E. O. Alternating Direction Galerkin Technique for Simulation of Contaminant Transport in Complex Groundwater Systems,	Application of the CREAMS Model as Part of an Overall System for Optimizing Environmen- tal Management in Lithuania, USSR: First Ex- periments, W86-00301 5B	GUPTA, R. P. Monitoring of Reservoir Volume Using Landsat Data,
W86-00072 5B	GOMES, M. I.	W86-00032 7C
FRINK, C. R. Effects of Acid Rain on Soil and Water, W86-00166 2K	Statistical Choice of Extremal Models for Complete and Censored Data, W86-00026	GUREGHIAN, A. B. One-Dimensional Analytical Solutions for the Migration of a Three-Member Radionuclide Decay Chain in a Multilayered Geologic
FROST, R. JR. Evaluation of a Hydrograph Shifting Method for Estimating Suspended-Sediment Loads in Il-	GOODMAN, K. S. Measurements of Damage, Recovery, and Rehabilitation of Coral Reefs Exposed to Oil,	Medium, W86-00081 5B
linois Streams, W86-00115 2J	W86-00243 5C	GUVEN, O. Analysis and Interpretation of Single-Well
FUCIK, K. W.	GOTO, H. H. High-Temperature Desalination Capability of	Tracer Tests in Stratified Aquifers, W86-00074 2F
Measurements of Damage, Recovery, and Reha- bilitation of Coral Reefs Exposed to Oil,	TFC 1501 Reverse Osmosis Element, W86-00265 3A	HAGER, W. H.
W86-00243 5C	GOUEVSKY, I. V.	B-Jumps at Abrupt Channel Drops, W86-00018 8B
GABOURY, D. R. Spatially Varying Rainfall and Floodrisk Analy-	Agricultural Water Demands, W86-00274 6D	HALBERT, D. J.
sis, W86-00012 2E	GOULTER, I. C.	Modeling of an ANFLOW Municipal Waste- Treatment Unit,
GANNING, B.	Optimal Urban Water Distribution Design,	W86-00246 5D
Recovery and Restoration of Rocky Shores, Sandy Beaches, Tidal Flats, and Shallow Subti-	W86-00071 5F GRACE, J. L.	HALE, T. W. Preliminary Appraisal of Sediment Sources and
dal Bottoms Impacted by Oil Spills, W86-00240 5C	Channel Control Structures for Souris River, Minot, North Dakota: Hydraulic Model Investi-	Transport in Kings Bay and Vicinity, Georgia and Florida,
GARCIA, A. W. Wave Data Acquisition and Hindcast for Sagi-	gation, W86-00209 8A	W86-00125 2J
naw Bay, Michigan, W86-00282 2H	GRAY, J. R.	HALL, J. F. 2,4-D Threshold Concentrations for Control of
GEORGAKAKOS, K. P. Synthesis of Radar Rainfall Data,	Runoff, Sediment Transport, and Water Quality in a Northern Illinois Agricultural Watershed before Urban Development, 1979-81,	Eurasian Watermilfoil and Sago Pondweed, W86-00208 4A
W86-00084 2A	W86-00133 2J	HAMILTON, D. B. Results of an Adaptive Environmental Assess
GERENCHER, E. Effects, Pathways, Processes, and Transforma- tion of Puget Sound Contaminants of Concern, W86-00293 5B	GRAY, N. F. Heterotrophic Slimes in Irish Rivers, Evaluation of the Problem, W86-00053 5B	the Marine Environment,

HAMILTON, S. E.	HINCKLEY, T. M.	HUTCHESON, M. R.
Hydrocarbons Associated with Suspended	Impact of Water Level Changes on Woody Ri-	Mixing Zone Model for Conservative Param-
Matter in the Green River, Washington,	parian and Wetland Communities; Volume IX:	eters,
W86-00196 5B	The Alaska Region,	
11 00 00170	W86-00292 2I	W86-00089 5G
HANKE, S. H.	W 00-00272	
Municipal Water Demands,	Impact of Water Level Changes on Woody Ri-	ICE, G. G.
W86-00275 6D		Review of Model Use in Evaluating Nonpoint
W 60-002/3	parian and Wetland Communities; Volume X:	Source Loads from Forest Management Activi-
STANCEN P M	Index and Addendum to Volumes I-VIII,	
HANSEN, E. M.	W86-00254 2I	ties,
Application of Probable Maximum Precipitation		W86-00091 5B
Estimates: United States East of the 105th Me-	HINMAN, M. L.	
ridian,	Release of Endothall from Aquathol Granular	IMES, J. L.
W86-00229 2B	Aquatic Herbicide,	
1100 00227	W86-00068 5G	Ground-Water Resources of Audrain County,
HARDT, W. F.	1100-03000	Missouri,
Public Water Supplies in Gloucester County,	HINWOOD, J. B.	W86-00113 2F
	Initial Dilution for Outfall Parallel to Current,	-
N.J.,	W86-00016 5B	IMHOFF, J. C.
W86-00174 2F	** 50-00010	
TIANT DU D M	HITE, J. E.	Hydrological Simulation Program-FORTRAN
HARLEY, B. M.	Barkley Dam Spillway Tainter Gate and Emer-	(HSPF): Users Manual for Release 8.0,
Application of the STORM Model to Design		W86-00199 2A
Problems in Singapore and in Kaosiung, Repub-	gency Bulkheads, Cumberland River, Kentucky:	
lic of China,	Hydraulic Model Investigation,	INOUCHI, K.
W86-00086 6A	W86-00284 8C	
W 00-00000		Regional Unsteady Interface Between Fresh
HARMSEN, L.	HOANG, D.	Water and Salt Water in a Confined Coastal
	Storm Sewer Optimum Design,	Aquifer,
Streamflow Losses Along the Balcones Fault	W86-00100 8B	W86-00042 2F
Zone, Nueces River Basin, Texas,		W 00-00042 2F
W86-00124 2E	HOEPPEL, R. E.	
	2,4-D Threshold Concentrations for Control of	JAFFE, P. R.
HARTE, J.		Sediment-Water Interface in Modeling Pesti-
Optimum Microcosms for Lake Ecotoxicology,	Eurasian Watermilfoil and Sago Pondweed,	cides in Sedimentation Ponds,
W86-00232 5C	W86-00208 4A	
W 80-00232		W86-00088 5B
HAVERKAMP, R.	HOLDEN, D. C.	
	Comparison of Two Daily Streamflow Simula-	JANSEN, G.
Infiltration Under Ponded Conditions: 1. Opti-	tion Models of an Alpine Watershed,	One-Dimensional Analytical Solutions for the
mal Analytical Solution and Comparison with	W86-00033 2E	
Experimental Observations,		Migration of a Three-Member Radionuclide
W86-00049 2G	HOLLAND, J. P.	Decay Chain in a Multilayered Geologic
	Technique to Optimally Locate Multilevel In-	Medium,
HELLER, P. L.		W86-00081 5B
Preliminary Evaluation of Lake Susceptibility to	takes for Selective Withdrawal Structures,	W 00-00001
	W86-00213 8A	TENTED IN IN
Water-Quality Degradation by Recreational	HOLLOD C 1	JENKE, D. R.
Use, Alpine Lakes Wilderness Area, Washing-	HOLLOD, G. J.	Computer Simulation of an Industrial
ton,	Locations and Areas of Ponds and Carolina	Wastewater Treatment Process,
W86-00114 5C	Bays at the Savannah River Plant,	
	W86-00263 2H	W86-00058 5D
HENDERSON, M.		
	HOLLYFIELD, N. W.	JENKINS, T. F.
Ground-Base Snow and Ice Crystal Observation	Functional Design of Control Structures for	Toxic Organics Removal Kinetics in Overland
System Used in Sierra Nevada Winter Orogra-		Flow Land Treatment,
phic Storms,	Oregon Inlet, North Carolina: Hydraulic Model	
W86-00222 2B	Investigation,	W86-00057 5D
	W86-00269 8B	
SCPP Data Collection and Analysis for the		JENSSEN, R. E.
Period 1 September 1981 through 31 August	HONG-YOU, R. L.	Wave Data Acquisition and Hindcast for Sagi-
	Analysis of Phenols by Chemical Derivatization.	
1982,	IV. Rapid and Sensitive Method for Analysis of	naw Bay, Michigan,
W86-00216 2B	21 Chlorophenols by Improved Chloroacetyla-	W86-00282 2H
HENDERSON, T.	tion Procedure,	JOHANSON, R. C.
SCPP Data Collection and Analysis for the	W86-00002 5A	Hydrological Simulation Program-FORTRAN
Period 1 September 1981 through 31 August		
1982.	HOOPES, J. A.	(HSPF): Users Manual for Release 8.0,
	Dispersion in Anisotropic, Homogeneous,	W86-00199 2A
W86-00216 2B	Porous Media,	
HENDRY D. C.	W86-00015 2F	JOHNSON, B. H.
HENDRY, D. G.		~
Laboratory Protocols for Evaluating the Fate of	HORTON, R.	Development of a Numerical Modeling Capabil-
Organic Chemicals in Air and Water,	Soil Water Evaporation Suppression by Sand	ity for the Computation of Unsteady Flow on
W86-00154 5A	Mulches,	the Ohio River and Its Major Tributaries,
		W86-00220 2E
HERWITZ, S. R.	W86-00050 2G	**************************************
Interception Storage Capacities of Tropical	HOSS, D. E.	TOTINGON B A
Rainforest Canopy Trees,		JOHNSON, R. A.
W86-00037 21	Fisheries Resource Impacts from Spills of Oil or	Results of an Adaptive Environmental Assess-
W 40-00037 21	Hazardous Substances,	ment Modeling Workshop- Concerning Poten-
HETDICK D.M.	W86-00244 5C	tial Impacts of Drilling Muds and Cuttings or
HETRICK, D. M.		tial impacts of Drining Muus and Cuttings of
SEDMNT: A Sediment Transport Submodel	HSU, LC.	the Marine Environment,
Based on Hydrodynamic Principles for the Uni-	Variance of the T-year Event in the Log Pear-	W86-00147 5C
fied Transport Model,	son Type-3 Distribution,	
W86-00155 2J		KADLEC, R. H.
	W86-00031 2E	
HIGUCHI, M.	UIIMPUDEV D	Chemicals and Wetlands,
	HUMPHREY, B.	W86-00233 50
Field Observations and Numerical Experiments	Fate of Chemically Dispersed Oil in the Sea: A	
on a Drying Front in a Volcanic Ash Soil Called	Report on Two Field Experiments,	KAIRIUKSTIS, L.
Kanto Loam,	W86-00172 5B	Application of the CREAMS Model as Part of
W86-00038 2F		Application of the CREAMS Model as Fait of
	HUNTER, C. A.	an Overall System for Optimizing Environmen
HILL, G.	Heterotrophic Slimes in Irish Rivers, Evaluation	tal Management in Lithuania, USSR: First Ex
Microcomputer Assisted Quality Assurance,	of the Problem.	periments,
W86-00203 5A	W86-00053 5E	
7.00-00203	50 00055	

KAKINUMA, T.

KAKINUMA, T. Regional Unsteady Interface Between Fresh Water and Salt Water in a Confined Coastal Aquifer,		LEGGETT, D. C. Toxic Organics Removal Kinetics in Overland Flow Land Treatment, W86-00057 5D
W86-00042 2F	KNISEL, W. G.	LENNON, C. A.
KALIN, K. Long-Term Ecological Behaviour of Abandoned Uranium Mill Tailings; 2.: Growth Pat		Flatiron AGC Interim Controller-Volume IV, W86-00223 8C
terns of Indigenous Vegetation on Terrestria and Semi-Aquatic Areas, W86-00217 50	Review of Case Studies of CREAMS Model Application,	LEONARD, R. A. CREAMS: A System for Evaluating Management Practices on Field-Size Areas,
	W 80-00302	W86-00295 5B
KARLINGER, M. R. Unit Hydrograph Approximations Assuming Linear Flow Through Topologically Random Channel Networks,	W86-00189 8G	LESLIE, T. H. Release of Endothall from Aquathol Granular Aquatic Herbicide,
W86-00082 2E	Effects, Pathways, Processes, and Transforma-	W86-00068 5G
KATZ, C. N. Dissolved Methane Concentrations in the South east Bering Sea, 1980 and 1981,	tion of Puget Sound Contaminants of Concern, W86-00293 5B	LETTENMAIER, D. P. Nonlinear Time-Variant Constrained Model for
W86-00180 2E		Rainfall-Runoff, W86-00022 2A
KAUPPI, L.	Synthesis of Radar Rainfall Data, W86-00084 2A	LEWIS, R. R.
Testing the Application of CREAMS to Finnish Conditions.	KRETSCHMAN, R. G.	Recovery and Restoration of Salt Marshes and
W86-00296 51	Year 1982, Volume 2. Colorado River Basin	Mangroves Following an Oil Spill, W86-00242 5C
KEEN, R. Toxicity to Daphnia of the End Products of We	above Dolores River, t W86-00128 7C	LI, RM.
Oxidation of Phenol and Substituted Phenole W86-00064 5I		Mechanistic Simulation for Transport of Non- point Source Pollutants,
KELLY-HANSEN, K.	W86-00166 2K	W86-00092 5B
Dissolved Methane Concentrations in the South east Bering Sea, 1980 and 1981,	KUO, C. Y.	LILJESTRAND, H. M.
W86-00180 21	nel Flow Using the K-epsilon Turbulence Model	Average Rainwater pH, Concepts of Atmos- pheric Acidity, and Buffering in Open Systems,
KEMPTON, J. P. Potential for Contamination of Shallow Aquifer		W86-00001 5B
in Illinois, W86-00178	W86-00003 2E	LINDH, G. Water and the City,
KERR, L. A.	LAGE, G. B. Chlorinated Organics in Simulated Groundwater	W86-00264 6D
Multiresidue Method for the Analysis and Ver fication of Several Herbicides in Water,		LINS, H. F.
W86-00046 5.		Interannual Steamflow Variability in the United States Based on Principal Components,
KINDLER, J. Methodological Framework,	Comparison of Two Daily Streamflow Simula- tion Models of an Alpine Watershed,	W86-00076 2E
W86-00272 6		LITTLE, J. R. Volunteer Lake Monitoring, 1981,
National Perspective in Water Demand Mode	LAND, L. F. Streamflow Losses Along the Balcones Fault	W86-00200 5C
	Zone, Nueces River Basin, Texas, W86-00124 2E	LOAICIGA, H. A. Dynamic Model for Multireservoir Operation,
Water Demand, W86-00271 6	LASSUS, C.	W86-00069 6A
KIRCHER, J. E. Trend Analysis of Salt Load and Evaluation the Frequency of Water-Quality Measuremen		Quadratic Model for Reservoir Management: Application to the Central Valley Project, W86-00070 6A
for the Gunnison, the Colorado, and the Dolor Rivers in Colorado and Utah, W86-00123	Pb Et Zn) Chez L'Eperlan (Osmerus mordax) Preleve Sur La Rive Nord De L'Estuaire du Saint-Laurent),	LORENZEN, M. W. Phytoplankton-Environmental Interactions in Reservoirs, Volume II: Discussion of Workshop
KIRKHAM, D.	W86-00059 5C	Papers and Open Literature,
Soil Water Evaporation Suppression by Sai Mulches,	Analytical Solutions for Periodic Well Recharge	
	G in Rectangular Aquifers with Third-Kind Boundary Conditions,	Availability of Water from the Alluvial Aquifer
KISHI, Y. Regional Unsteady Interface Between Fre Water and Salt Water in a Confined Coas		Washington,
Aquifer,	Variogram Identification by the Mean-Squared Interpolation Error Method with Application to	
KITTLE, J. L.	Hydrologic Fields,	Water Resources on the Pueblo of Laguna
Hydrological Simulation Program-FORTRA		West-Central New Mexico, W86-00108
(HSPF): Users Manual for Release 8.0, W86-00199	LEE, HB. Analysis of Phenols by Chemical Derivatization.	MAREY W. R.
KLEMES, I.	IV. Rapid and Sensitive Method for Analysis of 21 Chlorophenols by Improved Chloroacetyla	Laboratory Protocols for Evaluating the Fate of
Discrete-Time Linear Cascade under Ti- Averaging,	tion Procedure, W86-0002 5A	Wes colsa
	2A	MAGOUN, A. D.
KLEMES, V.	LEE, L. C. Impact of Water Level Changes on Woody Ri	. Aquatic Habitat Studies on the Lower Mississip
Discrete-Time Linear Cascade under Ti Averaging,	me parian and Wetland Communities; Volume IX The Alaska Region,	
	2A W86-00292 2	

MAIDMENT, D. R. Agricultural Water Demands, W86-00274 6D	Gould's Probability Matrix Method; 2. The Annual Autocorrelation Problem, W86-00030 2E	MORGAN, R. P. C. Predicting Hillslope Runoff and Erosion in the
MANSOURI-ALIABADI, M.	MCPHERSON, B. F.	United Kingdom: Preliminary Trials with the CREAMS Model, W86-00300 5B
Passage of Selected Heavy Metals From Sphaer- otilus (Bacteria: Chiamydobacteriales) to Para-	Nutrient Input from the Loxahatchee River En- vironmental Control District Sewage-Treatment	MORTON, M. R.
mecium caudatum (Protozoa: Ciliata), W86-00055	Plant to the Loxahatchee River Eatuary, South- eastern Florida, W86-00110 5B	Norfolk Harbor and Channels Deepening Study, Report 1: Physical Model Results, Chesapeake
MANSUE, J.	A STATE OF THE PROPERTY OF THE PROPERTY OF THE PARTY OF T	Bay Hydraulic Model Investigation, W86-00266 2L
Evaluation of a Hydrograph Shifting Method	MEIJERINK, A. M. J. Estimates of Peak Runoff from Hilly Terrain	W 80-00200
for Estimating Suspended-Sediment Loads in Il- linois Streams.	with Varied Lithology,	MUENCH, R. D.
W86-00115 2J	W86-00036 2E	Circulation in the Lower Cook Inlet, Alaska,
MARINO, M. A.	MELVILLE, J. G.	W86-00149 2L
Dynamic Model for Multireservoir Operation, W86-00069 6A	Analysis and Interpretation of Single-Well Tracer Tests in Stratified Aquifers,	MUIR, D. C. G. Laboratory and Field Studies on the Fate of
Quadratic Model for Reservoir Management:	W86-00074 2F	1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and Sediments.
Application to the Central Valley Project,	MENZ, F. C.	W86-00047 5B
W86-00070 6A	Acidification Impact on Fisheries: Substitution and the Valuation of Recreation Resources,	
MARKLE, D. G.	W86-00144 5G	MULHERN, M. R.
Wave Stability Study of Riprap-Filled Cells:	MEDITE M. I.	Current Measurements in the Columbia River Estuary,
Hydraulic Model Investigation,	MERRITT, M. L. Digital Simulation of the Regional Effects of	W86-00181 2L
W86-00283 8A	Subsurface Injection of Liquid Waste near Pen-	The sale sale and the analysis of the sale and the sale and
MARSALEK, J.	sacola, Florida,	MULLEN, J. K.
Energy Losses at Straight-Flow-Through Sewer	W86-00122 5B	Acidification Impact on Fisheries: Substitution and the Valuation of Recreation Resources,
Junctions,	MIDDELBURG, R. F.	W86-00144
W86-00103 8B	Trend Analysis of Salt Load and Evaluation of	Tree Signal Revent Manager Street
MARWITZ, J. D.	the Frequency of Water-Quality Measurements	MYERS, A. G.
Structure of Cold Fronts Over California,	for the Gunnison, the Colorado, and the Dolores Rivers in Colorado and Utah.	Removing Barium and Radium Through Calci- um Cation Exchange,
W86-00306 3B	W86-00123 5B	W86-00008 5F
MASSOTH, G. J.	MIKUTEL, D. F.	not the manufacture to the second of the
Sources, Composition, and Transport of Sus-	Groundwater Seepage Nutrient Loading in a	MYRICK, C.
pended Particulate Matter in Lower Cook Inlet	Florida Lake,	Navigation Conditions in Vicinity of Walter Bouldin Lock and Dam Coosa River Project:
and Northwestern Shelikof Strait, Alaska, W86-00150 2J	W86-00065 2H	Hydraulic Model Investigation,
TOP TO THE PROPERTY OF THE PARTY OF THE PART	MILES, C. J.	W86-00171 8A
MATHER, K.	Fate of Aldicarb, Aldicarb Sulfoxide, and Aldi-	MYRICK, C. M.
Modification of Bell Canyon Test (BCT) 1-FF Grout,	carb Sulfone in Floridan Groundwater, W86-00045 5B	Navigation Conditions at Mitchell Lock and
W86-00248 8G	Cartastic United Michigan Account of the Louis	Dam, Coosa River, Alabama,
MATHIS, D. B.	MILL, T.	W86-00177 8A
Aquatic Habitat Studies on the Lower Mississip-	Laboratory Protocols for Evaluating the Fate of Organic Chemicals in Air and Water,	NESTER, R. T.
pi River: River Mile 480-530; Report 3: Benthic	W86-00154 5A	Effects of Beach Nourishment on the Nearshore
Macroinvertebrate Studies Pilot Report,	MILLER, J. F.	Environment in Lake Huron at Lexington
W86-00212 6G	Application of Probable Maximum Precipitation	Harbor (Michigan), W86-00224 6G
MAYACK, L. A.	Estimates: United States East of the 105th Me-	miles are not not reduced to an a con-
Comparative Effectiveness of Antifouling Treat- ment Regimes using Chlorine or a Slow-Releas-	ridian, W86-00229 2B	NICKS, A. D.
ing Bromine Biocide,		CREAMS: A System for Evaluating Manage- ment Practices on Field-Size Areas,
W86-00063 5F	MITCHELL, L. J.	W86-00295 5E
MAYNORD, S. T.	Planning and Implementation of Regional Stormwater Management Facilities in Montgom-	HALLY CHIEF SECO ADVICAL CO.
Grays Landing Spillway and Stilling Basin,	ery County, Maryland,	NIEMCZYNOWICZ, J. Areal Intensity-Duration-Frequency Curves: A
Monongahela River, Pennsylvania: Hydraulic	W86-00099 4A	Possible Way of Improving the Rainfall Input,
Model Investigation, W86-00304 8B	MODAIHSH, A. S.	W86-00095 2E
TERM DATE OF THE PROPERTY OF T	Soil Water Evaporation Suppression by Sand	Attended to Incheses 600 Oct in Their in
MCCONNELL, J. B.	Mulches, W86-00050 2G	Attempt to Implement SWMM in Tunisia, W86-00087
Preliminary Appraisal of Sediment Sources and	W88-00030	The state of the s
Transport in Kings Bay and Vicinity, Georgia and Florida.	MOLZ, F. J.	NORRIS, L. A.
W86-00125 2J	Analysis and Interpretation of Single-Well Tracer Tests in Stratified Aquifers,	Ecotoxicology at the Watershed Level, W86-00234 5E
MCCOWN, D. L.	W86-00074 2F	11 30 - 02 31 - 12 31
Sampling and Detection of Tagged Dredged	MONTEITH, H. D.	O'NEIL, E. F.
Material,	Assessment of Heavy Metals and PCB's at Se-	Preventative Measures to Limit Stress Corrosion Cracking in Prestressed Concrete.
W86-00288 5A	lected Sludge Application Sites in Ontario,	W86.00249 8C
MCCOY, J. W.	W86-00102 5A	
Functional Design of Control Structures for	MORGAN, D. D. V.	O'NEIL, R. A.
Oregon Inlet, North Carolina: Hydraulic Model Investigation.	Predicting Hillslope Runoff and Erosion in the	
Investigation, W86-00269 8B	United Kingdom: Preliminary Trials with the CREAMS Model.	W86-00258 71
March Committee	W86-00300 5B	VI I I I I I I I I I I I I I I I I I I
MCMAHON, T. A. Gould's Probability Matrix Method; 1. The		OBEYSEKERA, J. T. B. Effects of Incorrectly Removed Periodicity in
Starting Month Problem,	MORGAN, D. R. Optimal Urban Water Distribution Design,	Parameters on Stochastic Dependence,
W86,00020	W86.0071 SE	W86-00075 24

OLIPHANT, J. L. Toxic Organics Removal Kinetics in Overland Flow Land Treatment,	PETERS, J. H. Uses of Recharge Wells in Water Supply, W86-00006 4B	Analysis of Inverted-T Retaining Walls and Floodwalls, W86-00193 8A
W86-00057 5D		THE RESERVE OF THE PERSON OF T
ORTH, R. Effects of Oil on Seagrass Ecosystems, W86-00241 5C	PETERSON, A. W. Water Surface at Change of Channel Curvature, W86-00019 8B	PURI, A. N. Numerical Modelling of Subcritical Open Chan- nel Flow Using the K-epsilon Turbulence Model
W86-00241 5C	PETERSON, J. A.	and the Penalty Function Finite Element Tech-
OSWALT, N. R. Grays Landing Spillway and Stilling Basin,	Stratigraphy and Sedimentary Facies of the Madison Limestone and Associated Rocks in	nique, W86-00003 2E
Monongahela River, Pennsylvania: Hydraulic Model Investigation,	Parts of Montana, Nebraska, North Dakota, South Dakota, Wyoming,	RADHAKRISHNANA, N. List of Soils, Soil-Structure Interaction and
W86-00304 8B	W86-00104 2F	Other Related Computer Programs Available
OVERLAND, J. E. Marine Weather of the Inland Waters of West-	PETRI, L. R. Time-of-Travel Data for Nebraska Streams, 1968 to 1977.	for LMVD Engineers, W86-00262 8D
ern Washington, W86-00165 2B	W86-00120 2E	RADTKE, D. B.
	PHIEN, H. N.	Preliminary Appraisal of Sediment Sources and
PACE, C. E. Program Criteria Specifications Document: Computer Program TWDA for Design and	Variance of the T-year Event in the Log Pear- son Type-3 Distribution, W86-00031 2E	Transport in Kings Bay and Vicinity, Georgia and Florida, W86-00125 2J
Analysis of Inverted-T Retaining Walls and Floodwalls.	Wes-notify	RAGSDALE, H. L.
W86-00193 8A	PHILLIPS, R. C. Effects of Oil on Seagrass Ecosystems,	Utility of Single Species and Ecosystem Tests in
PARASHAR, S. K.	W86-00241 5C	Assessing the Environmental Impact of Radio-
Use of Satellite Imagery for Tracking the Kur-	PICKERING, G. A.	nuclide Ecotoxicants, W86-00235 5B
distan Oil Spill, W86-00291 7B	Barkley Dam Spillway Tainter Gate and Emer-	W 60-00233
and the second s	gency Bulkheads, Cumberland River, Kentucky:	RAJARATNAM, N.
PARKER, L. V. Toxic Organics Removal Kinetics in Overland Flow Land Treatment.	Hydraulic Model Investigation, W86-00284 8C	Water Surface at Change of Channel Curvature, W86-00019 8B
W86-00057 5D	PINION, E.	RAM, S.
PARLANGE, J. Y.	Ground-Base Snow and Ice Crystal Observation System Used in Sierra Nevada Winter Orogra-	Hydraulics of a Well Pumped with Linearly
Infiltration Under Ponded Conditions: 1. Opti-	phic Storms,	Decreasing Discharge, W86-00040 2F
mal Analytical Solution and Comparison with Experimental Observations.	W86-00222	Source: Comments and Table 12.0 Created
W86-00049 2G	PINION, S.	RAYMOND, G. L. Techniques to Reduce the Sediment Resuspen-
PARSONS, F.	Ground-Base Snow and Ice Crystal Observation System Used in Sierra Nevada Winter Orogra-	sion Caused by Dredging,
Chlorinated Organics in Simulated Groundwater	phic Storms,	W86-00159 5G
Environments, W86-00007 5B	W86-00222 2B	REEVES, R. D.
pentalities of applications and areas	PIPES, W. O.	Streamflow Losses Along the Balcones Fault
PATTERSON, M. R. SEDMNT: A Sediment Transport Submodel	Sampling Frequency - Microbiological Drinking Water Regulations: Final Report,	Zone, Nueces River Basin, Texas, W86-00124 2E
Based on Hydrodynamic Principles for the Uni-	W86-00245 5A	
fied Transport Model, W86-00155	PLOSKEY, G. R.	REGENS, J. L. Acid Rain: Does Science Dictate Policy or
Several to actual control of Arternatived	Review of the Effects of Water-Level Changes	Policy Dictate Science,
PAULSON, E. G. JR. Regional Frequency Analysis of Multiyear	on Reservoir Fisheries and Recommendations for Improved Management,	W86-00137 6E
Droughts Using Watershed and Climatic Infor-	W86-00158 6G	REINERT, K. H.
mation, W86-00025	PLUMB, R. H.	Release of Endothall from Aquathol Granular
CONTRACTOR OF THE PARTY HARD	Procedures for Handling and Chemical Analysis	Aquatic Herbicide, W86-00068 5G
PEARSON, C. A. Circulation in the Lower Cook Inlet, Alaska,	of Sediment and Water Samples, W86-00198 5A	
W86-00149 2L		REINHOLD, R. E. Modification of Bell Canyon Test (BCT) 1-FF
PELD.	POE, T. P. Effects of Beach Nourishment on the Nearshore	Grout,
Condensed Disaggregation Model for Incorpo- rating Parameter Uncertainty Into Mouthly Res-	Environment in Lake Huron at Lexington Harbor (Michigan),	W86-00248 8G
ervoir Simulations,	W86-00224 6G	REISH, D. J. Recovery and Restoration of Rocky Shores,
W86-00073 2E	POPE, D. H.	Sandy Beaches, Tidal Flats, and Shallow Subti-
PEIRCE, J. J. Environmental Engineering,	Comparative Effectiveness of Antifouling Treat- ment Regimes using Chlorine or a Slow-Releas-	dal Bottoms Impacted by Oil Spills,
W86-00188 5F	ing Bromine Biocide,	W86-00240 5C
PENNINGTON, C. H.	1V86-00063 5F	RHODERICK, J. E.
Aquatic Habitat Studies on the Lower Mississip-	PORCELLA, D. B.	Modification of Bell Canyon Test (BCT) 1-FF Grout,
pi River: River Mile 480-530; Report 6: Larval	Phytoplankton-Environmental Interactions in	W86-00248 8G
Fish Studies Pilot Report, W86-00226 6G	Reservoirs, Volume II: Discussion of Workshop Papers and Open Literature,	
	W86-00206 2H	RICHARDS, D. R. Norfolk Harbor and Channels Deepening Study,
Fishes of Selected Aquatic Habitats on the Lower Mississippi River,	PREISENDORFER, R. W.	Report 1: Physical Model Results, Chesapeake
W86-00195 6G	Foundations of Principal Component Selection	Bay Hydraulic Model Investigation,
PERRY, C. A.	Rules,	W86-00266 2L
Natural Ground-Water-Recharge Data from		RISSER, D. W.
Three Selected Sites in Harvey County, South- Central Kansas,	PRICE, W. A. Program Criteria Specifications Document:	Water Resources on the Pueblo of Laguna West-Central New Mexico,
W86-00132 2F		W86-00108 2F

ROBILLARD, P. D.	SAPEK, A.	SEYHAN, E.
Planning Guide for Evaluating Agricultural Nonpoint Source Water Quality Controls, W86-00260 5G	Application of the CREAMS Model for Calcu- lation of Leaching of Nitrate from Light Soils in the Notec River Valley,	Determination of Resistance Parameters of Pluvio-Nivo-Glacial Alpine Systems by Mathe- matical Modeling of Runoff,
RODI, A. R.	W86-00298 5B	W86-00034 2E
Responses to Seeding Clouds with Dry Ice in the SCPP-1 Experiment,	SAUNDERS, P. A.	Hydrological Regionalisation: A Question of
W86-00307	Channel Control Structures for Souris River, Minot, North Dakota: Hydraulic Model Investi-	Problem and Scale,
RODRIGUEZ-ITURBE, I.	gation,	W86-00096 2E
Probabilistic Structure of Storm Surface Runoff,	W86-00209 8A	SHABICA, S
W86-00083 2E	SCHALLES, J. Locations and Areas of Ponds and Carolina	Ponds and Lagoons of Horn and Petit Bois Islands, Mississippi, Gulf Islands National Sea-
ROGERS, J. H. JR. Release of Endothall from Aquathol Granular	Bays at the Savannah River Plant,	shore: Their Physical Size, Literature Review
Aquatic Herbicide,	W86-00263 2H	and Recommendations for Future Research, W86-00278
W86-00068 5G	SCHNEIDER, R. A.	
ROJAS, N. N.	Classes of Ecotoxicological Tests: Their Advan- tages and Disadvantages for Regulation,	SHARMA, H. C. Hydraulics of a Well Pumped with Linearly
Large-Scale Operations Management Test of Use of the White Amur for Control of Problem	W86-00236 5C	Decreasing Discharge,
Aquatic Plants: The Herpetofauna of Lake	SCHRAMM, H. L.	W86-00040 2F
Conway, Species Accounts, W86-00202 6G	Aquatic Habitat Studies on the Lower Mississip- pi River: River Mile 480-530; Report 6: Larval	SHARP, R. E.
ROTHWELL, E. D.	Fish Studies Pilot Report,	Passage of Selected Heavy Metals From Sphaer- otilus (Bacteria: Chlamydobacteriales) to Para-
Grays Landing Spillway and Stilling Basin,	W86-00226 6G	mecium caudatum (Protozoa: Ciliata),
Monongahela River, Pennsylvania: Hydraulic Model Investigation,	SCHREINER, L. C.	W86-00055
W86-00304 8B	Application of Probable Maximum Precipitation Estimates: United States East of the 105th Me-	SHENG, Y. P.
RUBIN, A. J.	ridian, W86-00229 2B	Preliminary User's Manual 3-D Mathematical Model of Coastal, Estuarine, and Lake Currents
Inactivation of Naegleria gruberi Cysts by Chlo- rine Dioxide,	The Bollogia Papacitet by Oal Spillis, 2200-06 W	(CELC3D),
W86-00066 5F	SCHUMACHER, J. D. Circulation in the Lower Cook Inlet, Alaska,	W86-00168 2E
RUHL, J. R. and M. S. Ind. also and an arrange	W86-00149 2L	SHERIDAN, P. F.
Hydrogeologic and Water-Quality Characteris-	SCOTT, G. I.	Fisheries Resource Impacts from Spills of Oil or Hazardous Substances.
tics of the Mount Simon-Hinckley Aquifer, Southeast Minnesota,	Fisheries Resource Impacts from Spills of Oil or	W86-00244 5C
W86-00109 2K	Hazardous Substances, W86-00244 5C	SHERMAN, A. L.
RUSSELL, C. S.	SEABERGH, W. C.	Present and Prospective Use of Water by the
Methodological Framework, W86-00272 6D	Design for Prevention of Beach Erosion at	Manufacturing Industries of New Jersey, W86-00175 6D
National Perspective in Water Demand Model-	Presque Isle Beaches, Erie, Pennsylvania: Hydraulic Model Investigation,	T.O.JUAWE
ing, W86-00277	W86-00257 8B	SHIELDS, J. D. Locations and Areas of Ponds and Carolina
W86-00277	Functional Design of Control Structures for	Bays at the Savannah River Plant,
Programming Models for Regional Water	Oregon Inlet, North Carolina: Hydraulic Model Investigation,	W86-00263 2H
Demand Analysis, W86-00276 6D	W86-00269 8B	SHOWS, L. J.
Water Demand,	Weir Jetty Performance: Hydraulic and Sedi-	Channel Widths in Bends and Straight Reacher Between Bends for Push Towing: Hydraulic
W86-00271 6D	mentary Considerations, Hydraulic Model In-	Model Investigation,
RYAN, J. P.	vestigation, W86-00152	W86-00225
Use of Satellite Imagery for Tracking the Kur- distan Oil Spill,	SEFTON, D. F.	SHUVAL, H. I.
W86-00291 7B	Volunteer Lake Monitoring, 1981,	Wastewater Reuse and Exposure to Legionella Organisms,
SADEGHIPOUR, J.	W86-00200 5C	W86-00054 50
Regional Frequency Analysis of Multiyear Droughts Using Watershed and Climatic Infor-	SEIDEL, H. F.	SIMMERS, I.
mation,	Water Utility Operating Data: An Analysis, W86-00004 6D	Hydrological Regionalisation: A Question of Problem and Scale,
W86-00025 2A	SEMMENS, M. J.	W86-00096 2E
SAFIOLES, S. A. Preliminary Evaluation of Lake Susceptibility to	Removal by Coagulation of Trace Organics	SIMONS, D. B.
Water-Quality Degradation by Recreational	from Mississippi River Water, W86-00011 5F	Mechanistic Simulation for Transport of Non
Use, Alpine Lakes Wilderness Area, Washing-	SENECA, E. D.	point Source Pollutants, W86-00092 51
ton, W86-00114 5C	Recovery and Destoration of Salt Marshas and	PATATOMA SOURCES OF THE STREET
SALAMON, K. J.	Mangroves Following an Oil Spill, W86-00242	SJOREEN, A. L. SEDMNT: A Sediment Transport Submode
Long-Term Impact of Dredged Material Dispos-	Englished of Control Survey of Controls in	Based on Hydrodynamic Principles for the Uni
al in Lake Erie off Ashtabula, Ohio, W86-00162 5C	SENTER, P. K. List of Soils, Soil-Structure Interaction and	fied Transport Model, W86-00155 2.
SAMMEL, E. A.	Other Related Computer Programs Available	Abus marenary ammera season
Analysis and Interpretation of Data Obtained in	for LMVD Engineers, W86-00262 8D	SLAYMAKER, H. O. Estimation of Phosphorus Flux in a Regulated
Tests of the Geothermal Aquifer at Klamath Falls, Oregon,	SETMIRE, J. G.	Channel,
W86-00107 2F	Water-Quality Appraisal, Mammoth Creek and	
SANDER, L. G.	Hot Creek, Mono County, California, W86-00106	SMITH, A. E.
Aquatic Habitat Studies on the Lower Mississip- pi River: River Mile 480-530; Report 3: Benthic	SEWELL, W. R. D.	Laboratory and Field Studies on the Fate of 1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and
Macroinvertebrate Studies Pilot Report,	Water Demand,	Sediments,
W86-00212 6G	W86-00271 6D	W86-00047 51

SNOEYINK, V. L.

RNOEYINK, V. L. Removing Barium and Radium Through Calcium Cation Exchange, W86-00008 5F	STEMMLER, S. Environmental Effects of Nitrogen Fertilization Exemplified by Groundwater Pollution as Simulated by CREAMS,	TRACY, F. T. User's Guide for a Plane and Axisymmetric Finite Element Program for Steady-State Seepage Problems,
SNYDER, D. W.	W86-00297 5B	W86-00156 2G
Removing Barium and Radium Through Calci- um Cation Exchange, W86-00008	STEWARD, K. K. Improving Technology for Chemical Control of Aquatic Plants, W86-00183 4A	TRAN, H. N. Deposit Control Technology for Kraft Recovery Units, W86-00170 5D
SOLAK, M. Ground-Base Snow and Ice Crystal Observation System Used in Sierra Nevada Winter Orogra- phic Storms, W86-00222 2B	STEWART, S. Release of Endothall from Aquathol Granular Aquatic Herbicide, W86-00068 5G	TRELOAR, N. Effects, Pathways, Processes, and Transforma- tion of Puget Sound Contaminants of Concern,
SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August 1982, W86-00216 2B	STITT, S. C. Flatiron AGC Interim Controller-Volume IV, W86-00223 8C	W86-00293 5B TROUTMAN, B. M. Unit Hydrograph Approximations Assuming Linear Flow Through Topologically Random
SOMMER, U.	STONE, J. C. Industrial Water Demands,	Channel Networks, W86-00082
Seasonal Succession of Phytoplankton in Lake Constance.	W86-00273 6D	
Constance, W86-00051 2H SONNTAG, W. H.	STOWE, R. L. Engineering Condition Survey of Concrete in Service,	TSCHIRHART, J. T. Transferable Discharge Permits and Profit- Maximizing Behavior,
Nutrient Input from the Loxahatchee River Environmental Control District Sewage-Treatment	W86-00161 8F STRAUGHAN, D.	W86-00145 5G
Plant to the Loxahatchee River Estuary, South- eastern Florida,	Recovery and Restoration of Rocky Shores, Sandy Beaches, Tidal Flats, and Shallow Subti-	TSYKIN, E. N. Multiple Nonlinear Statistical Models for Runoff Simulation and Prediction,
W86-00110 5B	dal Bottoms Impacted by Oil Spills, W86-00240 5C	W86-00035 2E
SORACCO, R. J. Comparative Effectiveness of Antifouling Treatment Regimes using Chlorine or a Slow-Releas-	SUTPHEN, D. A. Large-Scale Operations Management Test of	TURNER, H. O. Dimensions for Safe and Efficient Deep-Draf
ing Bromine Biocide, W86-00063 5F	Use of the White Amur for Control of Problem Aquatic Plants: The Herpetofauna of Lake	Navigation Channels: Hydraulic Model Investigation,
SORRELL, R. K.	Conway, Species Accounts, W86-00202 6G	W86-00148
In-Home Treatment Methods for Removing Volatile Organic Chemicals, W86-00010 5F	SVETLOSANOV, V. Review of Case Studies of CREAMS Model	UGLAND, R. C. Water Resources Data for Colorado, Water Year 1982, Volume 2. Colorado River Basin
SPROUL, O. J. Inactivation of Naegleria gruberi Cysts by Chlo-	Application, W86-00302 5B	above Dolores River, W86-00128
rine Dioxide, W86-00066 5F	SWAIN, W. R. Ecosystem Approach to the Toxicology of Resi-	VAN DE GRIEND, A. A. Determination of Resistance Parameters of
SPRUILL, T. B. Assessment of Water Resources in Lead-Zinc Mined Areas in Cherokee County, Kansas, and	due Forming Xenobiotic Organic Substances in the Great Lakes, W86-00237 5B	Pluvio-Nivo-Glacial Alpine Systems by Mathe matical Modeling of Runoff, W86-00034
Adjacent Areas, W86-00121 5A	TATEM, H. E. Long-Term Impact of Dredged Material at Two	VAN DER KLOET, P.
SRIKANTHAN, R. Gould's Probability Matrix Method; 1. The	Open-Water Sites: Lake Eric and Elliot Bay; Evaluative Summary, W86-00160 5C	Two Algorithms For Parameter Estimation i Groundwater Flow Problems, W86-00044 21
Starting Month Problem, W86-00029 2E	THAYER, G.	VAN GEER, F. C.
Gould's Probability Matrix Method; 2. The Annual Autocorrelation Problem,	Effects of Oil on Seagrass Ecosystems, W86-00241 5C	Two Algorithms For Parameter Estimation i Groundwater Flow Problems, W86-00044
W86-00030 2E	Water Table in Rocks of Cenozoic and Paleozo-	VAN LOON, L. S.
STEDINGER, J. R. Condensed Disaggregation Model for Incorporating Parameter Uncertainty Into Mouthly Res-		Sampling and Detection of Tagged Dredge Material,
ervoir Simulations, W86-00073	along the second	W86-00288 5/
Minimum Variance Streamflow Record Aug- mentation Procedures,	Effects of Oil on Seagress Ecosystems, W86-00241 5C	VAN MONTFORT, M. A. J. Statistical Choice of Extremal Models for Conplete and Censored Data,
W86-00079 2E	THORNTON, H. T. Engineering Condition Survey of Concrete in	W86-00026 2.
STEELE, K. F. Karnes County, Texas, Area Hydrochemical and Stream Uranium Orientation Study.	Service,	VESILIND, P. A. Environmental Engineering,
W86-00194 2K	Sorption Behaviour of 14C in Groundwater/	W86-00188 5 VICENS, G. J.
STEFFLER, P. M. Water Surface at Change of Channel Curvature W86-00019		Spatially Varying Rainfall and Floodrisk Analysis,
STEINHEIMER, J. T.		W86-00012 2
Water Resources Data for Colorado, Water 1982, Volume 2. Colorado River Basin above Dolores River, W86-00128	mal Analytical Solution and Comparison with Experimental Observations,	Effects, Pathways, Processes, and Transform tion of Puget Sound Contaminants of Concer

VILAGINES, R.	WHITTEMORE, R. C.	WOODY, N. D.
Rapidity of RNA Synthesis in Human Cells; A	Review of Model Use in Evaluating Nonpoint	Locations and Areas of Ponds and Carolina
Highly Sensitive Parameter for Water Cytotoxi-	Source Loads from Forest Management Activi-	Bays at the Savannah River Plant,
city Evaluation,	ties,	W86-00263 2H
W86-00052 5A	W86-00091 5B	
VOGEL, R. M.	WHITTEMORE, T. R.	WORSFOLD, R. D.
Minimum Variance Streamflow Record Aug-	Flatiron AGC Interim Controller-Volume IV.	Use of Satellite Imagery for Tracking the Kur-
mentation Procedures.	W86-00223 8C	distan Oil Spill,
W86-00079 2E	W 60-00223 6C	W86-00291 7B
****	WHITTINGTON, D.	
WALKER, W. W.	Industrial Water Demands,	WU, J. S.
Some Recent Adaptations and Applications of	W86-00273 6D	Data Management for Continuous Hydrologic
QUAL-II in the Northeast, W86-00090 5B		Simulation,
W 60-00090	WILDE, E. W.	W86-00093 2A
WALLIS, I. G.	Comparative Effectiveness of Antifouling Treat-	
Initial Dilution for Outfall Parallel to Current,	ment Regimes using Chlorine or a Slow-Releas-	YARECHEWSKI, A. L.
W86-00016 5B	ing Bromine Biocide, W86-00063 5F	Laboratory and Field Studies on the Fate of
WALTER, B. A.	W86-00063 5F	1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and
Marine Weather of the Inland Waters of West-	WILKINSON, D. L.	Sediments,
ern Washington.	Seawater Circulation in Sewage Outfall Tunnels,	W86-00047 5B
W86-00165 2B	W86-00017 5E	
		YEVJEVICH, V.
WALTER, M. F.	WILLIAMS, L.	Effects of Incorrectly Removed Periodicity in
Planning Guide for Evaluating Agricultural	2,4-D Threshold Concentrations for Control of	Parameters on Stochastic Dependence,
Nonpoint Source Water Quality Controls,	Eurasian Watermilfoil and Sago Pondweed,	W86-00075 2A
W86-00260 5G	W86-00208 4A	
WALTON, R.	WILLIAMS B B	YOUNG, H. W.
Computer Modeling of Hydrodynamics and	WILLIAMS, R. R.	Evaluation of Hydrologic Processes Affecting
Solute Transport in Canals and Marinas: Litera-	Large-Scale Operations Management Test of Use of the White Amur for Control of Problem	
ture Review and Guidelines for Future Develop-	Plants: Selected Life History Information of	riagerman, idano,
ment,	Animal Species on Lake Conway, FL,	W86-00119 2G
W86-00179 5B	W86-00197 4A	
THE AMERICAN T	W 00-00157	Ground-water Conditions in the Cottonwood
WATKINS, J. Ponds and Lagoons of Horn and Petit Bois	WILLIAMS, S. J.	West Oakley Fan Area, South-Central Idaho
Islands, Mississippi, Gulf Islands National Sea-	Sand Resources and Geological Character of	W86-00117 2F
shore: Their Physical Size, Literature Review	Long Island Sound,	
and Recommendations for Future Research.	W86-00205 8E	
W86-00278 2H		Advantages of Dissolved-Air Flotation fo
1100-00270	WIUFF, R.	Water Treatment,
WAYLEN, P. R.	Transport of Suspended Material in Open and	W86-00005 51
Method of Predicting Daily Peak Flows in the	Submerged Streams,	
High-Flow Season,	W86-00013	
W86-00027 2E	WLOSINSKI, J. H.	Estimation of Phosphorus Flux in a Regulated
WEBBER, M. D.	Coefficients for Use in the U.S. Army Corps o	Channel,
Assessment of Heavy Metals and PCB's at Se-	Engineers Reservoir Model, CE-QUAL-R1,	W86-00062 5A
lected Sludge Application Sites in Ontario,	W86-00153 5I	
W86-00102 5A		ZIEMAN, J. C.
	WOJTOWICZ, R. J.	Effects of Oil on Seagrass Ecosystems,
WEBSTER, G. R. B.	Modeling of an ANFLOW Municipal Waste	- W86-00241 50
Laboratory and Field Studies on the Fate of	Treatment Unit,	PERSONAL PROPERTY AND ALL Y
1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and	W86-00246 5I	
Sediments, W86-00047 5B	WOLF, R. J.	Large-Scale Operations Management Test of
W 60-000-7		Use of the White Amur for Control of Problem
WEISNER, M. J.	Hydrogeologic and Water-Quality Characteristics of the Mount Simon-Hinckley Aquifer	
In-Home Treatment Methods for Removing	Southeast Minnesota.	· · · · · · · · · · · · · · · · · · ·
Volatile Organic Chemicals,	W86-00109 21	W86-00197 4/
W86-00010 5F	1100 00109	ZOLAN, W. J.
WESTERDAHL, H. E.	WONG, KC.	
2,4-D Threshold Concentrations for Control of	Effects of Spatial Variation in Amplitude an	
Eurasian Watermilfoil and Sago Pondweed,	Phase of the Oscillatory Tidal Currents on th	e nesia,
W86-00208 4A	Residual Lagrangian Drifts,	W86-00061 3
	W86-00085 21	ZWIERS, F. W.
WHITE, M. R.	WAARIAME W. W.	
Opportunities to Protect Instream Flows in	WOODHOUSE, W. W.	Foundations of Principal Component Selection Rules.
Alaska, W86-00280 6E	Shore Stabilization with Salt Marsh Vegetation	•
W86-00280 6E	W86-00189 80	3 W86-00186 7

4.5 (0.00)

present a figure of the con-	
T.	
Service of the servic	
the state of the s	
N are now to still the second	
object of the class	
a sharper produced to the state	
172	
* A C WEST CO. TO THE PT. 12/4.	
12 TA 10 CA 14 TA	
64 1 1 1 1 1 1	
A STATE OF THE STA	
	- 7
the Same of the State of the St	
10100	
16-	

4.1
-1
3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 -
1 0 10 1 0 10 1 11
0 00
10 × 101
(i * 01)
10 × 101
(i * 01)
loss of

2 10 TAY 41: 72: V

ORGANIZATIONAL INDEX

AERONAUTICAL RESEARCH ASSOCIATES OF PRINCETON, INC., NJ.	Techniques to Reduce the Sediment Resuspen- sion Caused by Dredging,	Development of a Numerical Modeling Capability for the Computation of Unsteady Flow or
Preliminary User's Manual 3-D Mathematical Model of Coastal, Estuarine, and Lake Currents	W86-00159 5G	the Ohio River and Its Major Tributaries, W86-00220 2E
(CELC3D),	Long-Term Impact of Dredged Material at Two	W 50-00220
W86-00168 2E	Open-Water Sites: Lake Erie and Elliot Bay; Evaluative Summary.	Channel Widths in Bends and Straight Reacher Between Bends for Push Towing: Hydraulic
AGRICULTURAL RESEARCH SERVICE,	W86-00160 5C	Model Investigation,
TIFTON, GA. SOUTHEAST WATERSHED	Flood Domes Alleviation in New Years	W86-00225
RESEARCH CENTER, CREAMS: A System for Evaluating Manage-	Flood Damage Alleviation in New Jersey, W86-00173 6F	Mission Bay Harbor, California, Design fo
ment Practices on Field-Size Areas,		Wave and Surge Protection and Flood Control
W86-00295 5B	Proceedings, 16th Annual Meeting, Aquatic Plant Control Research Planning and Operations	Hydraulic Model Investigation,
Review of Case Studies of CREAMS Model	Review.	W86-00255
Application,	W86-00192 4A	Edgewater Marina, Cleveland, Ohio: Design fo
W86-00302 5B	Fishes of Selected Aquatic Habitats on the	Wave Protection, Hydraulic Model Investiga
AGRICULTURAL UNIV., WAGENINGEN	Lower Mississippi River,	tion, W86-00256
(NETHERLANDS), DEPT. OF MATHEMATICS.	W86-00195 6G	
Statistical Choice of Extremal Models for Com-	Large-Scale Operations Management Test of	Design for Prevention of Beach Erosion a Presque Isle Beaches, Erie, Pennsylvania: Hy
plete and Censored Data,	Use of the White Amur for Control of Problem Plants: Selected Life History Information of	draulic Model Investigation,
W86-00026 2A	Animal Species on Lake Conway, FL,	W86-00257 81
ALBERTA UNIV., EDMONTON. DEPT. OF	W86-00197 4A	Norfolk Harbor and Channels Deepening Study
CIVIL ENGINEERING. Water Surface at Change of Channel Curvature,	2,4-D Threshold Concentrations for Control of	Report 1: Physical Model Results, Chesapeak
W86-00019 8B	Eurasian Watermilfoil and Sago Pondweed,	Bay Hydraulic Model Investigation, W86-00266 21
ALCOA OF ALVERNATIA TEN APPLECANCE	W86-00208 4A	W 80-00200
ALCOA OF AUSTRALIA LTD., APPLECROSS. Multiple Nonlinear Statistical Models for Runoff	Aquatic Habitat Studies on the Lower Mississip-	Functional Design of Control Structures fo
Simulation and Prediction,	pi River: River Mile 480-530; Report 3: Benthic Macroinvertebrate Studies Pilot Report,	Oregon Inlet, North Carolina: Hydraulic Mode Investigation,
W86-00035 2E	W86-00212 . 6G	W86-00269 81
AMES, IA.	Aquatic Habitat Studies on the Lower Mississip-	Poststorm Reconnaissance of Tropical Storm
Water Utility Operating Data: An Analysis, W86-00004 6D	pi River: River Mile 480-530; Report 6: Larval	Chris,
W 80-00004	Fish Studies Pilot Report,	W86-00279 21
ARGONNE NATIONAL LAB., IL. ENERGY	W86-00226 6G	Wave Data Acquisition and Hindcast for Sag
AND ENVIRONMENTAL SYSTEMS DIV. Sampling and Detection of Tagged Dredged	ARMY ENGINEER WATERWAYS	naw Bay, Michigan,
Material,	EXPERIMENT STATION, VICKSBURG, MS. HYDRAULICS LAB.	W86-00282
W86-00288 5A	Pointe Coupee Pumping Station Sump and	Wave Stability Study of Riprap-Filled Cells
ARKANSAS UNIV., FAYETTEVILLE.	Outlet Structure, Upper Pointe Coupee Loop Area, Louisiana: Hydraulic Model Investigation,	Hydraulic Model Investigation, W86-00283
ENGINEERING EXPERIMENT STATION. Nonlinear Time-Variant Constrained Model for	W86-00101 8C	W 00-00203
Rainfall-Runoff,	Dimensions for Safe and Efficient Deep-Draft	Barkley Dam Spillway Tainter Gate and Emer gency Bulkheads, Cumberland River, Kentucky
W86-00022 2A	Navigation Channels: Hydraulic Model Investi-	Hydraulic Model Investigation,
ARMY ENGINEER DISTRICT, ST. PAUL, MN.	gation, W86-00148 8B	W86-00284
Flood Control Minnesota River, Minnesota, Mankato-North Mankato-LeHillier: Design		Bloomington Spillway North Branch Potoms
Memorandum No. 8, Part I (Location Study).	Weir Jetty Performance: Hydraulic and Sedi- mentary Considerations, Hydraulic Model In-	River Maryland and West Virginia: Hydrauli
W86-00238 8A	vestigation,	Model Investigation, W86-00285
ARMY ENGINEER DIV, LOWER	W86-00152 8A	
MISSISSIPPI VALLEY, VICKSBURG, MS.	Public Water Supplies in Gloucester County,	Grays Landing Spillway and Stilling Basis Monongahela River, Pennsylvania: Hydrauli
Program Criteria Specifications Document: Computer Program TWDA for Design and	N.J., W86-00174 2F	Model Investigation,
Analysis of Inverted-T Retaining Walls and	W85-00174 2F	W86-00304 8
Floodwalls, W86-00193 8A	Improving Technology for Chemical Control of	ARMY ENGINEER WATERWAYS
***************************************	Aquatic Plants, W86-00183 4A	EXPERIMENT STATION, VICKSBURG, MS.
ARMY ENGINEER WATERWAYS		STRUCTURES LAB. Engineering Condition Survey of Concrete
EXPERIMENT STATION, VICKSBURG, MS. AUTOMATIC DATA PROCESSING CENTER.	Cleveland Harbor, Ohio: Design for the Safe and Efficient Passage of 1,000-ft-Long Vessels at	Service,
User's Guide for a Plane and Axisymmetric	the West (Main) Entrance, Hydraulic Model In-	W86-00161 8
Finite Element Program for Steady-State Seep- age Problems.	vestigation, W86-00204 8A	Modification of Bell Canyon Test (BCT) 1-F
W86-00156 2G		Grout,
List of Soils, Soil-Structure Interaction and	Channel Control Structures for Souris River, Minot, North Dakota: Hydraulic Model Investi-	W86-00248
Other Related Computer Programs Available	gation,	Preventative Measures to Limit Stress Corrosio
for LMVD Engineers, W86-00262 8D	W86-00209 8A	Cracking in Prestressed Concrete, W86-00249 8
**************************************	Technique to Optimally Locate Multilevel In-	
ARMY ENGINEER WATERWAYS	takes for Selective Withdrawal Structures,	ARMY MOBILITY EQUIPMENT RESEARCH
EXPERIMENT STATION, VICKSBURG, MS. ENVIRONMENTAL LAB.	W86-00213 8A	AND DEVELOPMENT COMMAND, FORT BELVOIR, VA.
Coefficients for Use in the U.S. Army Corps of	MeGee Creek Pumping Station Siphon, Pike	High-Temperature Desalination Capability
Engineers Reservoir Model, CE-QUAL-R1,	County, Illinois: Hydraulic Model Investigation,	TFC 1501 Reverse Osmosis Element, W86-00265

	ORGANITATIONAL IMPEY	
ARTHUR TECHNOLOGY, INC., FOND DU LAC,	ORGANIZATIONAL INDEX	
ARTHUR TECHNOLOGY, INC., FOND DU	Optimum Microcosms for Lake Ecotoxicology, W86-00232 5C	COASTAL ENGINEERING RESEARCH CENTER, VICKSBURG, MS.
New Concepts and Practices in Activated Sludge Process Control, W86-00221 5D	Classes of Ecotoxicological Tests: Their Advantages and Disadvantages for Regulation,	Barcelona Harbor, New York, Design for Harbor Improvements: Hydraulic Model Inves-
ASIAN INST. OF TECH., BANGKOK	W86-00236 5C	tigation, W86-00157 8A
(THAILAND). Variance of the T-year Event in the Log Pear-	CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR AND WATER RESOURCES.	Atchafalaya River Delta; Report 9: Wind Clima-
son Type-3 Distribution, W86-00031 2E	Dynamic Model for Multireservoir Operation, W86-00069 6A	tology, W86-00163 2L
ATMOSPHERICS, INC., FRESNO, CA.,		Atchafalaya River Delta; Report 8: Numerical
SCPP Data Collection and Analysis for the Period 1 September 1981 through 31 August 1982,	Quadratic Model for Reservoir Management: Application to the Central Valley Project, W86-00070 6A	Modeling of Hurricane-Induced Storm Surge, W86-00164 2A
W86-00216 2B	CAMP, DRESSER AND MCKEE, INC.,	Buhne Point, Humboldt Bay, California, Design
Ground-Base Snow and Ice Crystal Observation System Used in Sierra Nevada Winter Orogra-	ANNANDALE, VA. Characterization of Aerobic Chemical Processes	for the Prevention of Shoreline Erosion: Hy- draulic and Numerical Model Investigations,
phic Storms, W86-00222 2B	in Reservoirs: Problem Description and Model Formulation,	W86-00169 4D
AUBURN UNIV., AL. DEPT. OF CIVIL	W86-00176 5B	COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
ENGINEERING. Analysis and Interpretation of Single-Well	CAMP, DRESSER AND MCKEE, INC., BOSTON, MA.	Toxic Organics Removal Kinetics in Overland Flow Land Treatment,
Tracer Tests in Stratified Aquifers, W86-00074 2F	Application of the STORM Model to Design Problems in Singapore and in Kaosiung, Repub-	W86-00057 5D
BAGHDAD UNIV. (IRAQ), COLL. OF	lic of China, W86-00086 6A	COLORADO UNIV. AT BOULDER, DEPT. OF CIVIL, ENVIRONMENTAL, AND
ENGINEERING. Dispersion in Anisotropic, Homogeneous,	CANADA CENTRE FOR INLAND WATERS,	ARCHITECTURAL ENGINEERING. Comparison of Two Daily Streamflow Simula-
Porous Media, W86-00015 2F	BURLINGTON (ONTARIO). Analysis of Phenols by Chemical Derivatization.	tion Models of an Alpine Watershed,
BATTELLE PACIFIC NORTHWEST LABS.,	IV. Rapid and Sensitive Method for Analysis of 21 Chlorophenols by Improved Chloroacetyla-	W86-00033 2E
RICHLAND, WA. Mathematical Model, SERATRA, for Sediment- Contaminant Transport in Rivers and Its Appli-	tion Procedure, W86-00002 5A	COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, NORTH RYDE (AUSTRALIA), DIV. OF
cation to Pesticide Transport in Four Mile and Wolf Creeks in Iowa.	CANADA CENTRE FOR REMOTE SENSING, OTTAWA (ONTARIO).	MINERAL PHYSICS. Numerical Calculation of Saturated-Unsaturated
W86-00259 5B	Arctic Marine Oilspill Program (AMOP) Remote Sensing Study,	Infiltration in a Cracked Soil, W86-00078 2G
BATTELLE PROJECT MANAGEMENT DIV., COLUMBUS, OH. OFFICE OF NUCLEAR	W86-00258 7B	CONNECTICUT AGRICULTURAL
WASTE ISOLATION. One-Dimensional Analytical Solutions for the Migration of a Three-Member Radionuclide	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, GRENOBLE (FRANCE), INST, DE MECANIQUE DE GRENOBLE,	EXPERIMENT STATION, NEW HAVEN. Effects of Acid Rain on Soil and Water,
Decay Chain in a Multilayered Geologic Medium,	Variogram Identification by the Mean-Squared Interpolation Error Method with Application to	W86-00166 2K
W86-00081 5B	Hydrologic Fields,	CONSIGLIO NAZIONALE DELLE RICERCHE, PERUGIA (ITALY). IST. DI
BOSTON COLL., CHESTNUT HILL, MA. DEPT. OF GEOLOGY AND GEOPHYSICS. Interception Storage Capacities of Tropical	W86-00024 2A CH2M HILL, MILWAUKEE, WI.	RICERCA PER LA PROTEZIONE IDROGEOLOGICA NELL' ITALIA
Rainforest Canopy Trees, W86-0037	Removing Barium and Radium Through Calcium Cation Exchange,	CENTRALE. Analysis of the Effects of Orography on Surface
BRITISH COLUMBIA MINISTRY OF	W86-00008 5F	Rainfall by a Parameterized Numerical Model, W86-00023 2B
ENVIRONMENT, VANCOUVER. FISHERIES RESEARCH AND TECHNICAL SERVICES SECTION.	CHALMERS UNIV. OF TECHNOLOGY, GOETEBORG (SWEDEN). INSTITUTIONEN	CONTINENTAL SHELF ASSOCIATES, INC., BOULDER, CO.
Hypolimnetic Aeration: Practical Design and	FOER KAERNKEMI. Current Measurements in the Columbia River	Measurements of Damage, Recovery, and Reha-
Application, W86-00060 5G	Estuary, W86-00181 2L	bilitation of Coral Reefs Exposed to Oil, W86-00243 50
BRITISH GEOLOGICAL SURVEY, WALLINGFORD (ENGLAND).	CLARKSON UNIV., POTSDAM, NY. DEPT.	CORNELL UNIV., ITHACA, NY.
Block-Geometry Functions Characterizing Transport in Densely Fissured Media,	OF ECONOMICS. Acidification Impact on Fisheries: Substitution and the Valuation of Recreation Resources,	Planning Guide for Evaluating Agricultura Nonpoint Source Water Quality Controls, W86-00260 5G
W86-00039 2F	W86-00144 5G	
BUREAU OF RECLAMATION, DENVER, CO. ENGINEERING AND RESEARCH CENTER. Flatiron AGC Interim Controller-Volume IV,	COASTAL ENGINEERING RESEARCH CENTER, FORT BELVOIR, VA.	CORNELL UNIV., ITHACA, NY. DEPT. OF ENVIRONMENTAL ENGINEERING. Condensed Disaggregation Model for Incorpo
W86-00223 8C	Shore Stabilization with Salt Marsh Vegetation, W86-00189 8G	rating Parameter Uncertainty Into Mouthly Reservoir Simulations,
Seepage Analysis Using the Boundary Element Method,	Sand Resources and Geological Character of	W96 00073
W86-00228 2G	Long Island Sound, W86-00205 8E	DELAWARE UNIV., NEWARK. COLL. OF
CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.	Effects of Beach Nourishment on the Nearshore	MARINE STUDIES.
Lakes and Microcosms: Extending Microcosm Data to Aquatic Ecosystems,		
W86-00231 5C		

ORGANIZATIONAL INDEX

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.

DEPARTMENT OF AGRICULTURE, REGINA (SASKATCHEWAN). RESEARCH STATION. Multiresidue Method for the Analysis and Veri-	ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. DRINKING WATER RESEARCH DIV.	FLORIDA UNIV., GAINESVILLE, DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCES.
fication of Several Herbicides in Water, W86-00046 5A	In-Home Treatment Methods for Removing Volatile Organic Chemicals,	Fate of Aldicarb, Aldicarb Sulfoxide, and Aldicarb Sulfone in Floridan Groundwater,
DEDARTMENT OF PICHERIES AND	W86-00010 5F	W86-00045 5B
DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.	ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC, EFFLUENT	Estimation of Missing Values in Monthly Rain-
Laboratory and Field Studies on the Fate of 1,3,6,8-Tetrachlorodibenzo-p-dioxin in Soil and	GUIDELINES DIV. Development Document for Effluent Limita-	fall Series, W86-00094 2B
Sediments, W86-00047 5B	tions Guidelines and Standards for the Textile Mills Point Source Category.	GEOLOGICAL SURVEY, ALBUQUERQUE, NM. WATER RESOURCES DIV.
DEPARTMENT OF THE ENVIRONMENT,	W86-00207 5G	Water Resources on the Pueblo of Laguna,
OTTAWA (ONTARIO). Assessment of Heavy Metals and PCB's at Se-	ENVIRONMENTAL PROTECTION SERVICE, OTTAWA (ONTARIO).	West-Central New Mexico, W86-00108 2F
lected Sludge Application Sites in Ontario, W86-00102 5A	Winter Evaluation of Oil Skimmers and Booms. W86-00290 5G	GEOLOGICAL SURVEY, AUSTIN, TX.
DREXEL UNIV., PHILADELPHIA, PA. DEPT.	Ethylene: Environmental and Technical Infor-	WATER RESOURCES DIV.
OF BIOLOGICAL SCIENCES. Sampling Frequency - Microbiological Drinking	mation for Problem Spills. W86-00303 5C	Streamflow Losses Along the Balcones Fault Zone, Nueces River Basin, Texas,
Water Regulations: Final Report,	THE WALL WITH THE WALL	W86-00124 2E
W86-00245 5A	ENVIRONMENTAL PROTECTION SERVICE, OTTAWA (ONTARIO). WATER POLLUTION	GEOLOGICAL SURVEY, BISMARCK, ND,
DU PONT DE NEMOURS (E.L.) AND CO.,	CONTROL DIRECTORATE.	WATER RESOURCES DIV.
AIKEN, SC. SAVANNAH RIVER LAB.	Survey of Polychlorinated Biphenyls in Industri-	Water Resources Data, North Dakota, Water
Karnes County, Texas, Area Hydrochemical and Stream Uranium Orientation Study,	al Effluents in Canada. W86-00286 5B	Year 1981, Volume 1. Hudson Bay Basin. W86-00129 7C
W86-00194 2K	Annotated Bibliography on Northern Environ-	GEOLOGICAL SURVEY, BOISE, ID. WATER
Locations and Areas of Ponds and Carolina	mental Engineering, 1978-1979,	RESOURCES DIV.
Bays at the Savannah River Plant,	W86-00289 10C	Ground-Water Conditions in the Cottonwood-
W86-00263 2H	ENVIRONMENTAL RESEARCH LAB	West Oakley Fan Area, South-Central Idaho,
DUKE UNIV., DURHAM, NC. DEPT. OF	DULUTH, GROSSE ILE, ML LARGE LAKES	W86-00117 2F
CIVIL AND ENVIRONMENTAL	RESEARCH STATION. Ecosystem Approach to the Toxicology of Resi-	Evaluation of Hydrologic Processes Affecting
ENGINEERING.	due Forming Xenobiotic Organic Substances in	Soil Movement in the Hagerman Fauna Area,
Environmental Engineering, W86-00188 5F	the Great Lakes,	Hagerman, Idaho,
	W86-00237 5B	W86-00119 2G
E.V.S. CONSULTANTS LTD., NORTH VANCOUVER (BRITISH COLUMBIA).	ENVIRONMENTAL RESEARCH LAB., GULF	GEOLOGICAL SURVEY, DORAVILLE, GA.
Effects, Pathways, Processes, and Transforma-	BREEZE, FL. Fisheries Resource Impacts from Spills of Oil or	WATER RESOURCES DIV.
tion of Puget Sound Contaminants of Concern, W86-00293 5B	Hazardous Substances, W86-00244 5C	Preliminary Appraisal of Sediment Sources and Transport in Kings Bay and Vicinity, Georgia
ECOLE POLYTECHNIQUE FEDERALE DE		and Florida, W86-00125 2J
LAUSANNE (SWITZERLAND), CHAIRE DE CONSTRUCTIONS HYDRAULICS,	ESPEY, HUSTON AND ASSOCIATES, INC., AUSTIN, TX.	GEOLOGICAL SURVEY, HONOLULU, HI.
B-Jumps at Abrupt Channel Drops,	Advancement in Hydraulic Modeling of Porous Pavement Facilities,	WATER RESOURCES DIV.
W86-00018 8B	W86-00098 2E	Investigation of Waikele Well No. 2401-01, Oahu, Hawaii: Pumping Test, Well Logs and
ECOLOGICAL ANALYSTS, INC., SPARKS, MD.	FISH AND WILDLIFE SERVICE,	Water Quality,
Survey of National and State Regulatory Agency Policy and Procedures for the Determi-	FAYETTEVILLE, AR. NATIONAL RESERVOIR RESEARCH PROGRAM.	W86-00118 2K
nation of the Toxicity of Wastewater Effluents.	Review of the Effects of Water-Level Changes on Reservoir Fisheries and Recommendations	Water Resources Data Hawaii, Other Pacific Areas, Water Year 1981. Volume 2. Guam,
W86-00211 6E	for Improved Management,	Northern Mariana Islands, Federated States of
EDINGER (J.E.) ASSOCIATES, INC., WAYNE,	W86-00158 6G	Micronesia, Palau Islands and American Samoa.
PA.	FISH AND WILDLIFE SERVICE, FORT	W86-00130 7C
User Guide for LARM2: A Longitudinal-Verti- cal, Time-Varying Hydrodynamic Reservoir	COLLINS, CO. WESTERN ENERGY AND	GEOLOGICAL SURVEY, LAKEWOOD, CO.
Model,	LAND USE TEAM. Results of an Adaptive Environmental Assess-	WATER RESOURCES DIV.
W86-00190 5B	ment Modeling Workshop- Concerning Poten-	Unit Hydrograph Approximations Assuming
EHIME UNIV., MATSUYAMA (JAPAN).	tial Impacts of Drilling Muds and Cuttings on	Linear Flow Through Topologically Random Channel Networks,
DEPT. OF OCEAN ENGINEERING.	the Marine Environment, W86-00147 5C	W86-00082 2E
Regional Unsteady Interface Between Fresh		The state of the s
Water and Salt Water in a Confined Coastal Aquifer,	Guide to Stream Habitat Analysis Using the Instream Flow Incremental Methodology,	Water Table in Rocks of Cenozoic and Paleozo- ic Age, 1980, Yucca Flat, Nevada Test Site,
W86-00042 2F	W86-00251 6G	Nevada,
EMORY UNIV., ATLANTA, GA. DEPT. OF	FLORIDA INST. OF TECH., MELBOURNE,	W86-00116 2F
BIOLOGY.	DEPT. OF ENVIRONMENTAL SCIENCES	Trand Archair of Salt Load and Evaluation of
Utility of Single Species and Ecosystem Tests in	AND ENGINEERING.	Trend Analysis of Salt Load and Evaluation of the Frequency of Water-Quality Measurements
Assessing the Environmental Impact of Radio- nuclide Ecotoxicants,	Groundwater Seepage Nutrient Loading in a Florida Lake.	for the Gunnison, the Colorado, and the Dolores
W86-00235 5B		Rivers in Colorado and Utah,
		W86-00123 5B
ENVIRONMENTAL MONITORING AND SUPPORT LABCINCINNATI, OH.	FLORIDA INTERNATIONAL UNIV., MIAMI. DRINKING WATER RESEARCH CENTER.	Water Resources Data for Colorado, Water
Addendum to Handbook for Sampling and	Chlorinated Organics in Simulated Groundwater	Year 1982, Volume 2. Colorado River Basin
Sample Preservation.	Environments, W86-00007 5B	above Dolores River, W86-00128 7C
W86-00268 5A	W80-000/	11 30 00120

GEOLOGICAL SURVEY, LAWRENCE, KS. WATER RESOURCES DIV.

CROLOGICAL CURVEY LAWRENCE VC	GEOLOGICAL SURVEY, TACOMA, WA.	HADASSAH MEDICAL SCHOOL,
GEOLOGICAL SURVEY, LAWRENCE, KS. WATER RESOURCES DIV. Assessment of Water Resources in Lead-Zinc	WATER RESOURCES DIV. Ouality of Water, Ouillayute River Basin, Wash-	JERUSALEM (ISRAEL). ENVIRONMENTAL HEALTH LAB.
Mined Areas in Cherokee County, Kansas, and	ington,	Wastewater Reuse and Exposure to Legionella
Adjacent Areas,	W86-00111 2K	Organisms,
W86-00121 5A	Sediment Transport by Irrigation Return Flows	W86-00054 5C
Natural Ground-Water-Recharge Data from	in Four Small Drains Within the DID-18 Drain-	
Three Selected Sites in Harvey County, South-	age of the Sulphur Creek Basin, Yakima County,	ILLINOIS STATE ENVIRONMENTAL
Central Kansas, W86-00132 2F	Washington, April 1979 to October 1981, W86-00112 2J	PROTECTION AGENCY, SPRINGFIELD. DIV. OF WATER POLLUTION CONTROL.
CROLOGICAL SUBVEY LINCOLN NE	Availability of Water from the Alluvial Aquifer	Volunteer Lake Monitoring, 1981, W86-00200 5C
GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOURCES DIV.	in Part of the Green River Valley, King County,	W 60-00200
Time-of-Travel Data for Nebraska Streams,	Washington,	ILLINOIS STATE GEOLOGICAL SURVEY
1968 to 1977,	W86-00126 2F	DIV., CHAMPAIGN.
W86-00120 2E	GEOLOGICAL SURVEY, TALLAHASSEE, FL.	Present and Prospective Use of Water by the
GEOLOGICAL SURVEY, MENLO PARK, CA.	Nitrogen and Phosphorus Speciation and Flux in	Manufacturing Industries of New Jersey,
Stream Channel Stability Assessment,	a Large Florida River Wetland System, W86-00080 2H	W86-00175 6D
W86-00214 2J	W 80-00080	Potential for Contamination of Shallow Aquifers
GEOLOGICAL SURVEY, MENLO PARK, CA.	GEOLOGICAL SURVEY, TALLAHASSEE, FL.	in Illinois,
WATER RESOURCES DIV.	WATER RESOURCES DIV.	W86-00178 5E
Analysis and Interpretation of Data Obtained in	Nutrient Input from the Loxahatchee River En- vironmental Control District Sewage-Treatment	
Tests of the Geothermal Aquifer at Klamath Falls, Oregon,	Plant to the Loxahatchee River Estuary, South-	INLAND WATERS DIRECTORATE,
W86-00107 2F	eastern Florida,	VANCOUVER (BRITISH COLUMBIA).
	W86-00110 5B	WATER QUALITY BRANCH. Estimation of Phosphorus Flux in a Regulated
GEOLOGICAL SURVEY, ORLANDO, FL.	Digital Simulation of the Regional Effects of	Channel,
WATER RESOURCES DIV. Water Resources Data for Florida, Water Year	Subsurface Injection of Liquid Waste near Pen-	W86-00062 5A
1981 Volume 1: Northeast Florida.	sacola, Florida,	expectation and the state that ended to
W86-00127 7C	W86-00122 5B	INSTITUTE FOR LAND RECLAMATION AND
CEOLOGICAL SUBVEY BESTON VA	GEOLOGICAL SURVEY, URBANA, IL.	GRASSLAND FARMING, RASZYN (POLAND).
GEOLOGICAL SURVEY, RESTON, VA. Interannual Steamflow Variability in the United	WATER RESOURCES DIV.	Application of the CREAMS Model for Calcu-
States Based on Principal Components,	Evaluation of a Hydrograph Shifting Method	lation of Leaching of Nitrate from Light Soils in the Notec River Valley,
W86-00076 2E	for Estimating Suspended-Sediment Loads in Il- linois Streams,	W86-00298 5B
Navigation Conditions in Vicinity of Walter	W86-00115 2J	CHI CONTROL OF THE PARTY OF THE
Bouldin Lock and Dam Coosa River Project:		INTERNATIONAL INST. FOR AERIAL
Hydraulic Model Investigation,	Runoff, Sediment Transport, and Water Quality in a Northern Illinois Agricultural Watershed	SURVEY AND EARTH SCIENCES,
W86-00171 8A	before Urban Development, 1979-81,	ENSCHEDE (NETHERLANDS). Estimates of Peak Runoff from Hilly Terrain
GEOLOGICAL SURVEY, RESTON, VA.	W86-00133 2J	with Varied Lithology,
WATER RESOURCES DIV.	CEORGE WACHINGTON INTO	W86-00036 2E
National Water Summary 1983Hydrologic	GEORGE WASHINGTON UNIV., WASHINGTON, DC. INTERNATIONAL	
Events and Issues. W86-00131 6B	WATER RESOURCES INST.	INTERNATIONAL INST. FOR APPLIED
	Effects of Incorrectly Removed Periodicity in	SYSTEMS ANALYSIS, LAXENBURG
GEOLOGICAL SURVEY, ROLLA, MO.	Parameters on Stochastic Dependence, W86-00075 2A	(AUSTRIA). Methodological Framework,
WATER RESOURCES DIV. Stratigraphy and Sedimentary Facies of the	110000015	W86-00272 6D
Madison Limestone and Associated Rocks in	GEORGIA UNIV., ATHENS. INST. OF	***************************************
Parts of Montana, Nebraska, North Dakota,	NATURAL RESOURCES. Acid Rain: Does Science Dictate Policy or	National Perspective in Water Demand Model-
South Dakota, Wyoming,	Policy Dictate Science,	ing,
W86-00104 2F	W86-00137 6E	W86-00277 6D
Ground-Water Resources of Audrain County,	GOETTINGEN UNIV. (GERMANY, F.R.).	European and United States Case Studies in
Missouri,	Environmental Effects of Nitrogen Fertilization	Application of the CREAMS Model.
W86-00113 2F	Exemplified by Groundwater Pollution as Simu-	W86-00294 5E
GEOLOGICAL SURVEY, SACRAMENTO, CA.	lated by CREAMS,	
WATER RESOURCES DIV.	W86-00297 5B	IOWA STATE UNIV., AMES. DEPT. OF
Water-Quality Appraisal, Mammoth Creek and	GOVIND BALLABH PANT UNIV. OF	AGRONOMY.
Hot Creek, Mono County, California, W86-00106 5A	AGRICULTURE AND TECHNOLOGY,	Soil Water Evaporation Suppression by Sand Mulches,
	PLANTNAGAR (INDIA), DEPT, OF IRRIGATION AND DRAINAGE	W86-00050 2G
GEOLOGICAL SURVEY, SEATTLE, WA.	ENGINEERING.	Was and the second seco
WATER RESOURCES DIV. Historical Changes to Lake Washington and	Hydraulics of a Well Pumped with Linearly	JOHNS HOPKINS UNIV., BALTIMORE, MD.
Route of the Lake Washington Ship Canal, King	Decreasing Discharge, W86-00040 2F	DEPT. OF APPLIED ECONOMICS.
County, Washington,	W 60-000-0	Municipal Water Demands,
W86-00105 2H	GREENHORNE AND O'MARA, INC.,	W86-00275 6D
Preliminary Evaluation of Lake Susceptibility to	RIVERDALE, MD.	KATHOLIEKE UNIV. LEUVEN (BELGIUM).
Water-Quality Degradation by Recreational	Planning and Implementation of Regional Stormwater Management Facilities in Montgom-	LAB, OF SOIL PHYSICS.
Use, Alpine Lakes Wilderness Area, Washing-	ery County, Maryland,	Comparing the Performance of Root-Water
ton, W86-00114 5C	W86-00099 4A	Uptake Models,
W 50-00114	GRIFFITH UNIV., NATHAN (AUSTRALIA).	W86-00048 2I
GEOLOGICAL SURVEY, ST. PAUL, MN.	SCHOOL OF AUSTRALIAN	VEHIDINGSINGSTITUT VOOR
WATER RESOURCES DIV.	ENVIRONMENTAL STUDIES,	KEURINGSINSTITUUT VOOR WATERLEIDINGARTIKELEN, RIJSWIJK
Hydrogeologic and Water-Quality Characteris- tics of the Mount Simon-Hinckley Aquifer,		(NETHERLANDS).
Southeast Minnesota.	Experimental Observations,	Uses of Recharge Wells in Water Supply,
W96 00100	W/96 00040	11/04 00004 A1

ORGANIZATIONAL INDEX

NATIONAL WEATHER SERVICE, SILVER SPRING, MD. OFFICE OF HYDROLOGY.

LIMNOLOGICAL INST.	MURFREESBORO.	ADMINISTRATION, BOULDER, CO.
Seasonal Succession of Phytoplankton in Lake	Passage of Selected Heavy Metals From Sphaer-	ENVIRONMENTAL RESEARCH LABS.
Constance, W86-00051 2H	otilus (Bacteria: Chlamydobacteriales) to Para- mecium caudatum (Protozoa: Ciliata).	Boulder Upslope Cloud Observation Experi- ment.
KOZPONTI METEOROLOGIAI INTEZET,	W86-00055 5C	W86-00261 2B
BUDAPEST (HUNGARY).	MIDWEST RESEARCH INST., KANSAS CITY,	NATIONAL OCEANIC AND ATMOSPHERIC
Soil Moisture Content: Statistical Estimation of Its Probability Distribution,	MO.	ADMINISTRATION, SEATTLE, WA. PACIFIC
W86-00021 2G	Statistical Analysis of Precipitation Frequency in the Conterminous United States, Including	MARINE ENVIRONMENTAL LAB. Circulation in the Lower Cook Inlet, Alaska,
LITHUANIAN RESEARCH INST. OF	Comparisons with Precipitation Totals, W86-00020 2B	W86-00149 2L
FORESTRY, VILNIUS (USSR).	W86-00020 2B	Sources, Composition, and Transport of Sus-
Application of the CREAMS Model as Part of an Overall System for Optimizing Environmen-	MINNESOTA UNIV., MINNEAPOLIS, DEPT. OF CIVIL AND MINING ENGINEERING.	pended Particulate Matter in Lower Cook Inlet
tal Management in Lithuania, USSR: First Ex-	Removal by Coagulation of Trace Organics	and Northwestern Shelikof Strait, Alaska, W86-00150 21
periments, W86-00301 5B	from Mississippi River Water,	W86-00150 2J
7-11.50	W86-00011 5F	Suspended Particulate Matter in Elliott Bay,
LOTIC ENTERPRISES, BAKERSFIELD, CA.	MONASH UNIV., CLAYTON (AUSTRALIA).	W86-00151 2J
Microcomputer Assisted Quality Assurance, W86-00203 5A	DEPT. OF MECHANICAL ENGINEERING.	Marine Weather of the Inland Waters of West-
	Initial Dilution for Outfall Parallel to Current,	ern Washington,
LUND UNIV. (SWEDEN).	W86-00016 5B	W86-00165 2B
Attempt to Implement SWMM in Tunisia, W86-00087 6A	MONTANA COLL. OF MINERAL SCIENCE	Neclarity Condition of Minks N X - 1
	AND TECHNOLOGY, BUTTE. DEPT. OF	Navigation Conditions at Mitchell Lock and Dam, Coosa River, Alabama,
LUND UNIV. (SWEDEN). DEPT. OF WATER	CHEMISTRY AND GEOCHEMISTRY.	W86-00177 8A
RESOURCES ENGINEERING. Areal Intensity-Duration-Frequency Curves: A	Computer Simulation of an Industrial Wastewater Treatment Process,	
Possible Way of Improving the Rainfall Input,	W86-00058 5D	STREX TOVS/Radiosonde Comparison, Part I:
W86-00095 2B	THE STATE OF THE S	TOVS/AVHRR and Radiosonde Inventory, W86-00187 7B
Water and the City,	MONTGOMERY (JAMES M.), INC., SALT	W 80-00187
W86-00264 6D	LAKE CITY, UT.	Hydrocarbons Associated with Suspended
TOTAL AND PROPERTY OF THE PARTY.	Regional Frequency Analysis of Multiyear Droughts Using Watershed and Climatic Infor-	Matter in the Green River, Washington,
Application of the CREAMS Model: Western Skane, Sweden,	mation,	W86-00196 5B
W86-00299 5B	W86-00025 2A	NATIONAL RESEARCH COUNCIL,
	MUSKEGON COUNTY BOARD, MI, DEPT.	WASHINGTON, DC. COMMITTEE TO
MACLAREN ENGINEERS, WINNIPEG	OF PUBLIC WORKS.	REVIEW METHODS FOR ECOTOXICOLOGY.
(MANITOBA). Optimal Urban Water Distribution Design,	Chemistry for Operators,	Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems.
W86-00071 5F	W86-00134 5F	W86-00230 5C
MAGGACIETICIPEDO INCOMO OD MOCEL	NATIONAL AERONAUTICS AND SPACE	
MASSACHUSETTS INST. OF TECH., CAMBRIDGE.	ADMINISTRATION, HUNTSVILLE, AL.	NATIONAL SPACE TECHNOLOGY LABS.,
Spatially Varying Rainfall and Floodrisk Analy-	GEORGE C. MARSHALL SPACE FLIGHT	NSTL STATION, MS.
sis,	CENTER.	Ponds and Lagoons of Horn and Petit Bois Islands, Mississippi, Gulf Islands National Sea-
W86-00012 2E	Monitoring Marine Microbial Fouling. W86-00227 5A	shore: Their Physical Size, Literature Review
MASSACHUSETTS INST. OF TECH., OAK	Walter and the second second	and Recommendations for Future Research,
RIDGE, TN. SCHOOL OF CHEMICAL	NATIONAL BOARD OF WATERS, HELSINKI	W86-00278 2H
ENGINEERING PRACTICE. Modeling of an ANFLOW Municipal Waste-	(FINLAND).	NATIONAL TECHNICAL INFORMATION
Treatment Unit,	Computer Modeling of Hydrodynamics and Solute Transport in Canals and Marinas: Litera-	SERVICE, SPRINGFIELD, VA.
W86-00246 5D	ture Review and Guidelines for Future Develop-	Oil Shale Mining, Processing, Uses, and Envi
MCMASTER UNIV., HAMILTON (ONTARIO).	ment,	ronmental Impacts, 1978-July, 1981: Citations from the NTIS Data Base.
Snowmelt Induced Urban Runoff in Northern	W86-00179 5B	W86-00201 40
Sweden,	Testing the Application of CREAMS to Finnish	
W86-00097 2C	Conditions,	Oil Shale Mining, Processing, Uses, and Environmental Impacts, August, 1981-October, 1982
MELBOURNE UNIV., PARKVILLE	W86-00296 5B	Citations from the NTIS Data Base.
(AUSTRALIA). DEPT. OF CIVIL	NATIONAL COLL, OF AGRICULTURAL	W86-00215 5E
ENGINEERING. Gould's Probability Matrix Method; 1. The	ENGINEERING, SILSOE (ENGLAND).	
Starting Month Problem,	Predicting Hillslope Runoff and Erosion in the	NATIONAL WATER RESEARCH INST., VANCOUVER (BRITISH COLUMBIA).
W86-00029 2E	United Kingdom: Preliminary Trials with the CREAMS Model,	Energy Losses at Straight-Flow-Through Sewe
Could's Probability Matter Mathed 2 The	W86-00300 5B	Junctions,
Gould's Probability Matrix Method; 2. The Annual Autocorrelation Problem.	0.0000000000000000000000000000000000000	W86-00103 8I
W86-00030 2E	NATIONAL COUNCIL OF THE PAPER	NATIONAL WEATHER SERVICE, SILVER
	INDUSTRY FOR AIR AND STREAM IMPROVEMENT INC., NEW YORK.	SPRING, MD. HYDROLOGIC RESEARCH
MICHIGAN DEPT. OF PUBLIC HEALTH, LANSING. SECTION OF WATER SUPPLY.	Review of Model Use in Evaluating Nonpoint	LAB.
Hydraulics for Operators,	Source Loads from Forest Management Activi-	Synthesis of Radar Rainfall Data,
W86-00135 8B	ties,	W86-00084 2/
MICHIGAN TECHNOLOGICAL UNIV.,	W86-00091 5B	NATIONAL WEATHER SERVICE, SILVER
HOUGHTON, DEPT. OF BIOLOGICAL	NATIONAL HYDROLOGY RESEARCH INST.,	SPRING, MD. OFFICE OF HYDROLOGY.
SCIENCES.	OTTAWA (ONTARIO).	Application of Probable Maximum Precipitation
Toxicity to Daphnia of the End Products of Wet		Estimates: United States East of the 105th Meridian.
Oxidation of Phenol and Substituted Phenols, W86-00064 5D		

ORGANIZATIONAL INDEX

NATIONAL WEATHER SERVICE TRAINING CENTER, KANSAS CITY, MO.

NATIONAL WEATHER SERVICE TRAINING	Methods for Ecological Toxicology: A Critical Review of Laboratory Multispecies Tests.	RESEARCH PLANNING INST., INC., COLUMBIA, SC.
CENTER, KANSAS CITY, MO. Outline of Severe Local Storms with the Mor-	W86-00210 5C	Recovery and Restoration of Salt Marshes and
phology of Associated Radar Echoes, W86-00146 2B	OHIO STATE UNIV., COLUMBUS, DEPT. OF	Mangroves Following an Oil Spill, W86-00242 5C
1200	CIVIL ENGINEERING.	STANSON PARADIDADADA DEL PARADIDA DEL PARADI
NEW JERSEY DEPT. OF ENVIRONMENTAL PROTECTION, TRENTON.	Inactivation of Naegleria gruberi Cysts by Chlo- rine Dioxide, W86-00066 5F	RESOURCES FOR THE FUTURE, INC., WASHINGTON, DC.
Fate of Chemically Dispersed Oil in the Sea: A Report on Two Field Experiments,	and the second second second	Legal, Ethical, Economic and Political Aspects of Transfrontier Pollution,
W86-00172 5B	OKLAHOMA UNIV., NORMAN. DIV. OF ECONOMICS.	W96 00143 6E
NEW JERSEY DEPT. OF ENVIRONMENTAL	Normative Economics and the Acid Rain Prob-	
PROTECTION, TRENTON. DIV. OF WATER RESOURCES.	lem, W86-00141	Programming Models for Regional Water Demand Analysis,
Deposit Control Technology for Kraft Recov-	Economic Impact of Acid Precipitation: A Ca-	W86-00276 6D
ery Units, W86-00170 5D	nadian Perspective, W86-00142 6C	RISSHO UNIV., TOKYO (JAPAN). DEPT. OF
NEW JERSEY INST. OF TECH., NEWARK.		GEOGRAPHY.
DEPT. OF CIVIL AND ENVIRONMENTAL	OKLAHOMA WATER RESOURCES BOARD, OKLAHOMA CITY.	Field Observations and Numerical Experiments on a Drying Front in a Volcanic Ash Soil Called
ENGINEERING. Leachate from Hazardous Wastes Sites,	Mixing Zone Model for Conservative Param-	Kanto Loam,
W86-00247 5B	eters,	W86-00038 2F
	W86-00089 5G	POOPUTE INTEL COURT OF FARME
NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). WATER RESEARCH LAB.	OPERATIONAL ECONOMICS, INC., HOUSTON, TX.	ROORKEE UNIV. (INDIA). DEPT. OF EARTH SCIENCES.
Seawater Circulation in Sewage Outfall Tunnels, W86-00017 5E	Industrial Water Demands,	Monitoring of Reservoir Volume Using Landsat
W86-00017 5E	W86-00273 6D	Data, W86-00032 7C
NORTH CAROLINA UNIV. AT CHARLOTTE.	OREGON STATE UNIV., CORVALLIS, DEPT.	THE STATE OF THE S
DEPT. OF URBAN AND ENVIRONMENTAL	OF AGRICULTURAL ECONOMICS.	SASKATCHEWAN UNIV., SASKATOON.
ENGINEERING. Data Management for Continuous Hydrologic	Economically Relevant Response Estimation	DEPT. OF GEOGRAPHY.
Simulation,	and the Value of Information: Acid Deposition, W86-00139 6B	Method of Predicting Daily Peak Flows in the High-Flow Season,
W86-00093 2A	W 30-00137	W86-00027 2E
NORTH TEXAS STATE UNIV., DENTON.	PACIFIC NORTHWEST FOREST AND	Commence of the commence of th
DEPT. OF BIOLOGICAL SCIENCES.	RANGE EXPERIMENT STATION, CORVALLIS, OR. FORESTRY SCIENCES	SCIENCE AND EDUCATION
Release of Endothall from Aquathol Granular Aquatic Herbicide,	LAB.	ADMINISTRATION, FORT LAUDERDALE, FL. AQUATIC PLANT MANAGEMENT LAB.
W86-00068 5G	Ecotoxicology at the Watershed Level, W86-00234 5B	Dissolved Methane Concentrations in the South- east Bering Sea, 1980 and 1981,
NORTHEASTERN FOREST EXPERIMENT	PRINCETON UNIV., NJ. DEPT. OF CIVIL	W86-00180 2K
STATION, BEREA, KY.	ENGINEERING.	MANAGER OF USE OF STATE OF STATE
Stream Water Quality in the Coal Region of West Virginia and Maryland,	Sediment-Water Interface in Modeling Pesti-	SCRIPPS INSTITUTION OF
W86-00253 5B	cides in Sedimentation Ponds, W86-00088 5B	OCEANOGRAPHY, LA JOLLA, CA. Foundations of Principal Component Selection
NORTHEASTERN FOREST EXPERIMENT	PURDUE UNIV., LAFAYETTE, IN. DEPT. OF	Rules,
STATION, BROOMALL, PA.	AGRICULTURAL ENGINEERING.	W86-00186 7C
Stream Water Quality in the Coal Region of Alabama and Georgia,	ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) User's	SEAKEM OCEANOGRAPHY LTD., SIDNEY
W86-00250 5B	Manual.	(BRITISH COLUMBIA).
Stream Water Quality in the Coal Region of	W86-00287 4D	Sorption Behaviour of 14C in Groundwater/ Rock and in Groundwater/Concrete Environ-
Ohio,	QUEBEC UNIV., RIMOUSKI. DEPT. OF	ments.
W86-00267 5B	OCEANOGRAPHY.	W86-00184 5B
Stream Water Quality in the Coal Region of	Heavy Metal Accumulation (Cd, Cu, Pb and	
Pennsylvania,	Zn) by Smelt (Osmerus mordax) From the North Shore of the St Lawrence Estuary (Accu-	SERVICE DE CONTROLE DES EAUX DE LA VILLE DE PARIS (FRANCE).
W86-00281 5B	mulation de Quelques Metaux Lourds (Cd, Cu,	Rapidity of RNA Synthesis in Human Cells; A
NORTHWEST COLORADO COUNCIL OF	Pb Et Zn) Chez L'Eperlan (Osmerus mordax) Preleve Sur La Rive Nord De L'Estuaire du	Highly Sensitive Parameter for Water Cytotoxi-
GOVERNMENTS, FRISCO.	Saint-Laurent),	city Evaluation, W86-00052 5A
Point Sources-Nonpoint Sources Trading in the Lake Dillon Watershed.	W86-00059 5C	W80-00032
W86-00167 5B	REEVE (DOUGLAS) AND ASSOCIATES,	SIMONS, LI AND ASSOCIATES, INC., FORT
	TORONTO (ONTARIO).	COLLINS, CO.
NORTHWEST MICHIGAN REGIONAL PLANNING AND DEVELOPMENT	Hydrological Yearbook: 1980.	Mechanistic Simulation for Transport of Non- point Source Pollutants,
COMMISSION, TRAVERSE CITY.	W86-00182 2A	W86-00092 5B
Groundwater Management Strategy for Michi-	REMOTEC APPLICATIONS LTD., ST.	
gan: Economic and Social Impacts of Ground- water Contamination; A Case Study in East Bay	JOHN'S (NEWFOUNDLAND). Use of Satellite Imagery for Tracking the Kur-	SRI INTERNATIONAL, MENLO PARK, CA.
Township, Grand Traverse County, Michigan.	distan Oil Spill,	Laboratory Protocols for Evaluating the Fate of Organic Chemicals in Air and Water,
W86-00218 5C	W86-00291 7B	W86-00154 SA
OAK RIDGE NATIONAL LAB., TN.	RENSSELAER POLYTECHNIC INST., TROY,	WITCHISTON OF CHARLES AND A STORY
ENVIRONMENTAL SCIENCES DIV.	NY. DEPT. OF BIOLOGY.	STATE UNIV. OF NEW YORK COLL. AT
SEDMNT: A Sediment Transport Submodel Based on Hydrodynamic Principles for the Uni-	Comparative Effectiveness of Antifouling Treat-	BUFFALO. GREAT LAKES LAB. Procedures for Handling and Chemical Analysis
fied Transport Model,	ment Regimes using Chlorine or a Slow-Releas- ing Bromine Biocide,	of Sediment and Water Samples,
W86-00155 2J	W86-00063 5F	W86-00198 5A

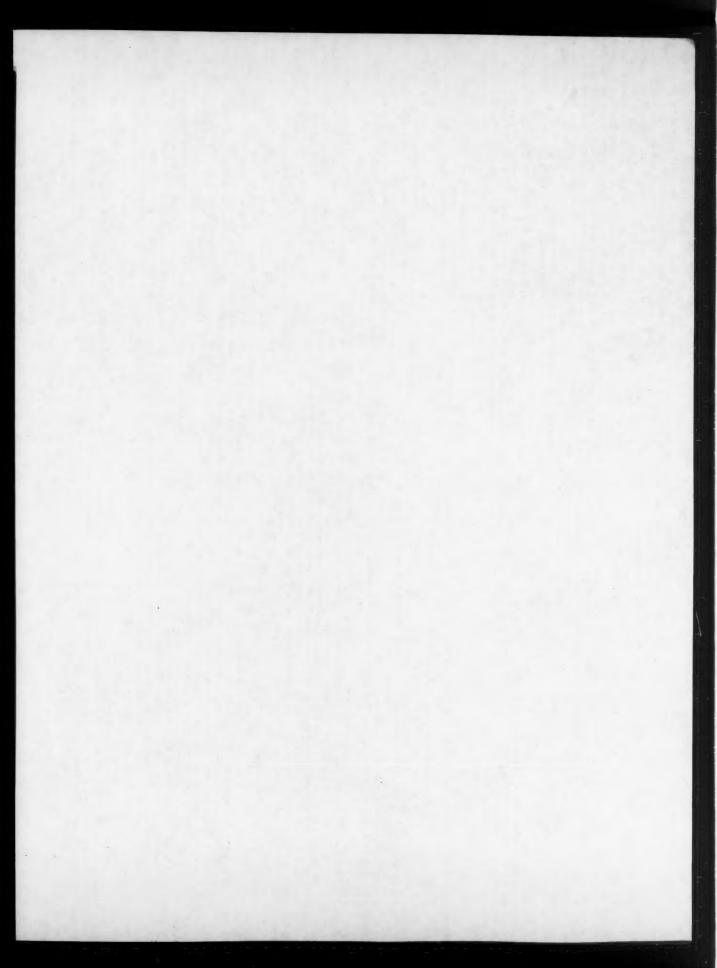
STIRLING UNIV. (SCOTLAND), DEPT. OF ENVIRONMENTAL SCIENCE,	UNIVERSIDAD SIMON BOLIVAR, CARACAS (VENEZUELA). GRADUATE PROGRAM IN	WATER RESEARCH CENTRE, MARLOW (ENGLAND).
Runoff from Glacierized Mountains: A Model	HYDROLOGY AND WATER RESOURCES.	Effects on Groundwater Quality of the Intro-
for Annual Variation and Its Forecasting, W86-00077 2E	Probabilistic Structure of Storm Surface Runoff, W86-00083 2E	duction of Secondary Sewage Treatment to an Effluent Recharge Site on the Chalk of Southern
STOCKHOLM UNIV. (SWEDEN), DEPT. OF		England,
ZOOLOGY.	UNIVERSITY COLL. OF NORTH WALES, MENAI BRIDGE, MARINE SCIENCE LABS,	W86-00043 5D
Recovery and Restoration of Rocky Shores, Sandy Beaches, Tidal Flats, and Shallow Subti-	Tracer Applications of Ultra-Violet Absorption Measurements in Coastal Waters,	WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
dal Bottoms Impacted by Oil Spills, W86-00240 5C	W86-00056 2L	Advantages of Dissolved-Air Flotation for Water Treatment,
SWEDISH COUNCIL FOR BUILDING	UNIVERSITY OF SOUTH FLORIDA, TAMPA,	W86-00005 5F
RESEARCH, STOCKHOLM. Flow Balancing Method for Stormwater and	DEPT. OF BIOLOGY. Large-Scale Operations Management Test of	WATERLOO UNIV. (ONTARIO), DEPT. OF
Combined Sewer Overflow.	Use of the White Amur for Control of Problem	EARTH SCIENCES,
W86-00191 5D	Aquatic Plants: The Herpetofauna of Lake Conway, Species Accounts,	Alternating Direction Galerkin Technique for Simulation of Contaminant Transport in Com-
TECHNICAL UNIV. OF DENMARK, LYNGBY.	W86-00202 6G	plex Groundwater Systems,
INST. OF HYDRODYNAMICS AND		W86-00072 5E
HYDRAULIC ENGINEERING. Transport of Suspended Material in Open and	UNIVERSITY OF THE PACIFIC, STOCKTON,	WEST VIDODIIA IDIIV MODOANTOUNI
Submerged Streams,	CA.	WEST VIRGINIA UNIV., MORGANTOWN, DEPT, OF ECONOMICS.
W86-00013 2J	Hydrological Simulation Program—FORTRAN (HSPF): Users Manual for Release 8.0,	Effect of Global Optimization on Locally Optimal Pollution Control: Acid Rain,
TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS). DEPT. OF CIVIL	W86-00199 2A	W86-00138 60
ENGINEERING.	VIRGINIA POLYTECHNIC INST. AND STATE	WESTERN INDUSTRIAL LABS, LTD.,
Two Algorithms For Parameter Estimation in Groundwater Flow Problems,	UNIV., BLACKSBURG. DEPT. OF AGRICULTURAL ENGINEERING.	EDMONTON (ALBERTA).
W86-00044 2F	Rainwater Catchment Water Quality in Micronesia,	Evaluation of the 'Lectro Clear Z' Electrocoa gulation Process for Meat Packing Wastewate
TETRA TECH, INC., BELLEVUE, WA.	W86-00061 3B	Treatment.
Phytoplankton-Environmental Interactions in Reservoirs, Volume II: Discussion of Workshop	VIRGINIA POLYTECHNIC INST. AND STATE	W86-00252 5E
Papers and Open Literature,	UNIV., BLACKSBURG, DEPT, OF CIVIL	WESTON (ROY F.), INC., WEST CHESTER,
W86-00206 2H	ENGINEERING.	PA.
TEXAS UNIV. AT AUSTIN, DEPT. OF	Numerical Modelling of Subcritical Open Chan-	Long-Term Impact of Dredged Material Dispos al in Lake Erie off Ashtabula, Ohio,
ENVIRONMENTAL HEALTH ENGINEERING. Average Rainwater pH, Concepts of Atmos-	nel Flow Using the K-epsilon Turbulence Model and the Penalty Function Finite Element Tech-	W86-00162 56
pheric Acidity, and Buffering in Open Systems,	nique,	WISCONSIN UNIVMILWAUKEE, DEPT. OF
W86-00001 5B	W86-00003 2E	CIVIL ENGINEERING. Unified Theory for Microbial Growth under
TEXAS UNIV. AT DALLAS, RICHARDSON.	VIRGINIA UNIV., CHARLOTTESVILLE.	Multiple Nutrient Limitation,
GRADUATE PROGRAM IN ENVIRONMENTAL SCIENCES.	DEPT. OF ENVIRONMENTAL SCIENCES.	W86-00067 21
Microbiological Water Quality of Impound-	Effects of Oil on Seagrass Ecosystems, W86-00241 5C	
ments: A Literature Review,	W 60-00241	WORCESTER POLYTECHNIC INST.,
W86-00185 5A	VRIJE UNIV., AMSTERDAM	HOLDEN, MA. ALDEN RESEARCH LABS. Surface Buoyant Jets in Steady and Reversin
THESSALONIKI UNIV., SALONIKA	(NETHERLANDS).	Crossflows,
(GREECE). SCHOOL OF TECHNOLOGY. Analytical Solutions for Periodic Well Recharge	Hydrological Regionalisation: A Question of Problem and Scale,	W86-00014 51
in Rectangular Aquifers with Third-Kind	W86-00096 2E	WYOMING UNIV., LARAMIE. DEPT. OF
Boundary Conditions,	VDITE UNITY AMOTERNAM	ATMOSPHERIC SCIENCE.
W86-00041 2F	VRIJE UNIV., AMSTERDAM (NETHERLANDS). DEPT. OF	Cloud Physics Studies in the SCPP: Interin Progress Report, 1983-84.
TORONTO UNIV. (ONTARIO). INST. FOR ENVIRONMENTAL STUDIES.	HYDROGEOLOGY AND GEOGRAPHICAL HYDROLOGY.	W86-00305
Long-Term Ecological Behaviour of Aban- doned Uranium Mill Tailings; 2.: Growth Pat-	Determination of Resistance Parameters of	Structure of Cold Fronts Over California,
terns of Indigenous Vegetation on Terrestrial	Pluvio-Nivo-Glacial Alpine Systems by Mathe- matical Modeling of Runoff,	W86-00306 3
and Semi-Aquatic Areas, W86-00217 5C	W86-00034 2E	Responses to Seeding Clouds with Dry Ice i
	WASHINGTON UNIV., SEATTLE. COLL. OF	the SCPP-1 Experiment,
TRINITY COLL., DUBLIN (IRELAND).	FOREST RESOURCES,	W86-00307
ENVIRONMENTAL SCIENCES UNIT. Heterotrophic Slimes in Irish Rivers, Evaluation	Impact of Water Level Changes on Woody Ri- parian and Wetland Communities; Volume X:	WYOMING UNIV., LARAMIE. DEPT. OF ECONOMICS.
of the Problem,	Index and Addendum to Volumes I-VIII,	Scientific Truths and Policy Truths in Aci
W86-00053 5B	W86-00254 2I	Deposition Research,
TUFTS UNIV., MEDFORD, MA. DEPT. OF	V	W86-00140 6
CIVIL ENGINEERING.	Impact of Water Level Changes on Woody Ri- parian and Wetland Communities; Volume IX:	Transferable Discharge Permits and Profit-Max
Minimum Variance Streamflow Record Augmentation Procedures,	The Alaska Region,	Transferable Discharge Permits and Profit-Max mizing Behavior,
W86-00079 2E		

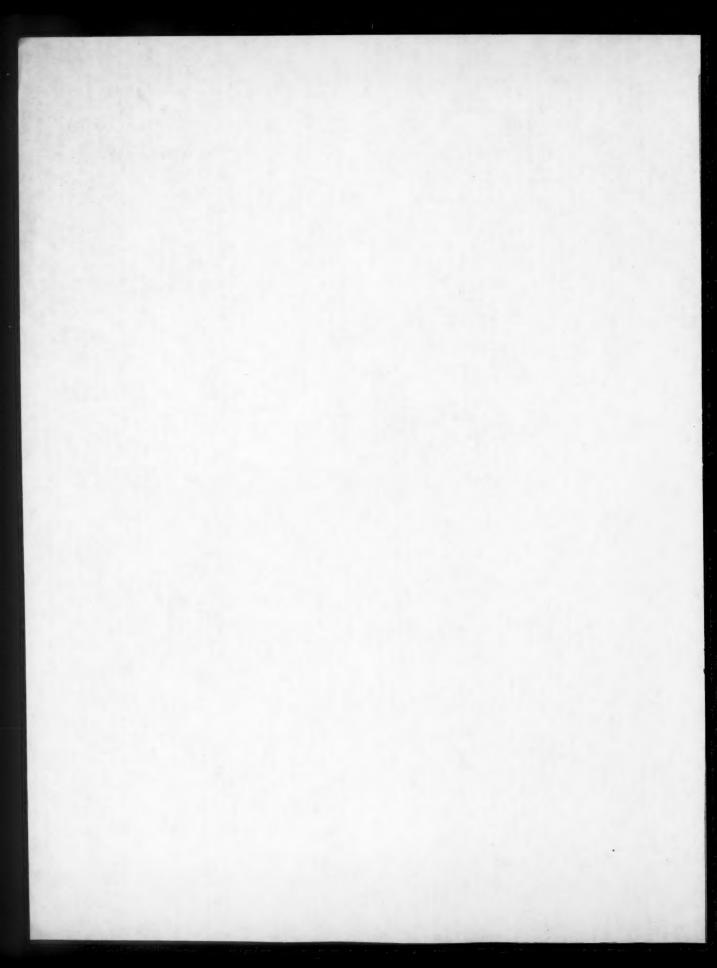
ACCESSION NUMBER INDEX

W8-60001 5B W8-600079 2E W8-60015 3D W8-60023 5C W8-60003 2E W8-60006 3D W8-60003 3E W8-60007 8G W8-60003 3E W8-600015 8G W8-60003 3E W8-600015 8G W8-60003 3E W8-600015 8G W8-600015 3D W8								
W8-60003 ZE	W86-00001	5B	W86-00078	2G	W86.00155	21	Wee 00222	**
W8-00003 2E								
W8-00005 5F W8-00081 3B W8-00195 6G W8-00213 5B W8-00005 5F W8-00005 1B W8-00081 2B W8-0006 6B W8-0007 3F W8-00081 2B W8-00106 5C W8-00213 5B W8-00081 2B W8-00081 2B W8-00081 3C W8-00213 5B W8-00081 2B W8-00081 3C W8-00213 8A W8-00081 3F W8-00081 4A W8-00161 3C W8-00213 8A W8-0009 5F W8-00081 5B W8-00161 3C W8-00213 5C W8-00010 5F W8-00081 5B W8-00161 3C W8-00161 3C W8-00101 5F W8-00081 5B W8-00161 3C W8-00161 3C W8-00161 3C W8-00161 3C W8-0011 5F W8-00081 5B W8-00161 3C W8-0017								
W8-00005 9F W8-00082 2E W8-00199 5G W8-00215 5C W8-00217 5B W8-00084 2A W8-0016 18C W8-00213 5C W8-00213 5C W8-00213 5C W8-00213 5C W8-00213 5C W8-00213 5C W8-00210 5F W8-00086 6A W8-0016 18C W8-00213 5C W8-00210 5F W8-00086 5C W8-00210 5F W8-00085 5B W8-00210 18F W8-00085 5B W8-00210 18F W8-00085 5B W8-00210 18F W8-00210	W86-00004							
W86-00005 3B	W86-00005	5F						
W86-00015 3F W86-0008 3F W86-0008 3L W86-0016 3F W86-0009 5F W86-0008 3F W86-0	W86-00006	4B	W86-00083					
W86-0000 SF W86-0008 C W86-0010 SF W86-0008 A W86-0010 SF W86-0008 A W86-0010 SF W86-0008 A W86-0010 SF W86-0008 A W86-0010 SF W86-0008 SP W86-0008 SP W86-0010 SP W86-0008 SP W86-0010 SP W86-0008 SP W86-0010 SP		5B						
W85-00009 SF W85-00018 SF W85-00010 SF<	W86-00008	5F						
W86-00010 SF W86-0008 5B W86-0008 5B W86-0010 SF W86-00011 SF W86-00010 SF W86-0001	W86-00009	5F	W86-00086	6A				
W86-00013 21 W86-0008 50 W86-0016 2B W86-0024 2C W86-0013 21 W86-0005 3B W86-0016 2E W86-00034 5C W86-0013 12 W86-0005 3B W86-0016 2E W86-00034 5C W86-0013 12 W86-00013 12 W8	W86-00010	5F	W86-00087					
W86-00013 2E W86-0009 5B W86-0016 2E W86-00014 5D W86-00014 5D W86-00015 1B W86-000	W86-00011	5F	W86-00088	5B				
W85-0014 21	W86-00012	2E	W86-00089	5G		2K		
W86-00015 2F W86-00092 3B W86-00093 2A W86-00016 3D W86-00046 3D W86-00016 3B W86-00019 3B W86-00021 2G W86-00022 2A W86-00019 3B W86-00019 3B W86-00023 2A W86-00010 8B W86-00018 3B W86-00018 3B W86-00018 3B W86-00018 3B W86-00019 3B W86-00023 2A W86-00010 3B W86-00019 3B W86-00023 2A W86-00010 3B W86-00019 3B W86-00023 2A W86-00010 3B W86-00010 3B W86-00023 2A W86-00010 3B W86-00012 2A W86-00010 3B W86-00023 2A W86-00010 3B W86-00010 3B W86-00023 2A W86-00010 3B W86-00010 3B W86-00023 2B W86-00010 3B W86-0	W86-00013	2J	W86-00090	5B				
W8-00013	W86-00014	5B	W86-00091	5B		2E		
W8-00017 SE			W86-00092	5B		4D		
W8-00017 SR				2A	W86-00170	5D		
W8-00019 BB				2B	W86-00171	8A		
W85-00020 B				2B	W86-00172	5B		
W86-00023						6F		
W\$6-00022 A						2F		
W\$6-00023 2A					W86-00175	6D		
W86-00025						5B		
W8-00025 2A								
W8-00025 ZA								
W86-00027 ZE								-
W8-00023								
W86-00039 ZE								
W86-00030 ZE						2A		
W86-00031 ZE								
W86-00032 TC								
W86-00133 ZE								
W86-00134 2E W86-00111 2K W86-00188 5F W86-00264 6D W86-00035 2E W86-00112 21 W86-00180 8G W86-00266 2L W86-00037 2I W86-00114 2C W86-00191 3D W86-00267 2B W86-00039 2F W86-00116 2F W86-00191 3D W86-00268 5A W86-00039 2F W86-00116 2F W86-00193 8A W86-00269 8B W86-00040 2F W86-00118 2K W86-00193 8A W86-00271 6D W86-00041 2F W86-00119 2G W86-00195 6G W86-00271 6D W86-00043 3D W86-00120 2E W86-00197 4A W86-00271 6D W86-00044 2F W86-00122 3B W86-00193 5A W86-00273 6D W86-00045 5B W86-00122 3B W86-00193 5A W86-00273								
W86-0035 ZE								
W85-00130 2E W85-00113 2F W85-00190 3D W86-00266 2L W85-0016 2J W85-00191 3D W86-00267 3B W86-00267 3B W86-00267 3B W86-00267 3B W86-00267 3B W86-00268 3A W86-00268 3A W86-00268 3A W86-00269 8B W86-00269 8B W86-00269 3B W86-00270 6D W86-0018 2K W86-0019 2K W86-0018 2K W86-0019 3B W86-00270 6D W86-00271 6D W86-00271 6D W86-00271 6D W86-00271 6D W86-00271 6D W86-00272 6D W86-00272 6D W86-00272 6D W86-00272 6D W86-00272 6D W86-00273 6D								
W86-00037 21 W86-00115 21 W86-00191 3D W86-00267 3B W86-00039 2F W86-00115 2J W86-00193 4A W86-00268 8A W86-00040 2F W86-00117 2F W86-00194 2K W86-00270 6D W86-00041 2F W86-00112 2F W86-00195 6G W86-00271 6D W86-00042 2F W86-00119 2G W86-00196 5B W86-00272 6D W86-00043 5D W86-00121 5A W86-00198 5A W86-00273 6D W86-00045 5B W86-00122 3B W86-00198 5A W86-00273 6D W86-00045 5B W86-00122 3B W86-00198 5A W86-00273 6D W86-00047 5B W86-00122 3B W86-00109 2A W86-00276 6D W86-00047 5B W86-00126 2F W86-00200 4C W86-00276								
W86-00038 2F W86-00115 2J W86-00192 4A W86-00269 8B W86-00040 2F W86-00117 2F W86-00193 3A W86-00270 6D W86-00041 2F W86-00118 2K W86-00195 6G W86-00271 6D W86-00040 2F W86-00119 2G W86-00195 5B W86-00272 6D W86-00043 3D W86-00120 2E W86-00197 4A W86-00273 6D W86-00045 3B W86-00121 5A W86-00197 4A W86-00275 6D W86-00045 3B W86-00123 3B W86-00209 2A W86-00275 6D W86-00047 5B W86-00123 3B W86-00200 5C W86-00276 6D W86-00048 2D W86-00125 2J W86-00200 5C W86-00276 6D W86-00049 2G W86-00125 2J W86-00200 5C W86-00278								
W86-00090 2F W86-00116 2F W86-00193 8A W86-00209 8B W86-00040 2F W86-00117 2F W86-00194 2K W86-00270 6D W86-00041 2F W86-00119 2G W86-00196 5B W86-00271 6D W86-00043 5D W86-00111 2A W86-00197 4A W86-00273 6D W86-00044 2F W86-00121 5A W86-00198 5A W86-00274 6D W86-00045 5B W86-00123 5B W86-00199 2A W86-00275 6D W86-00047 5B W86-00123 5B W86-00200 5C W86-00276 6D W86-00047 5B W86-00123 5B W86-00200 5C W86-00277 6D W86-00048 2D W86-00124 2E W86-00200 5C W86-00277 6D W86-00048 2D W86-00126 2F W86-00203 5A W86-00278								
W86-00040 ZF								
W86-00041 2F W86-00118 2K W86-00195 6G W86-00271 6D W86-00042 2F W86-00120 2E W86-00197 4A W86-00273 6D W86-00044 2F W86-00121 5A W86-00198 5A W86-00273 6D W86-00045 5B W86-00122 5B W36-00199 2A W86-00274 6D W86-00046 5A W86-00123 5B W36-00200 5C W86-00276 6D W86-00047 5B W86-00123 5B W86-00200 5C W86-00276 6D W86-00049 2G W86-00125 2J W36-00201 4C W86-00277 6D W86-00049 2G W86-00127 7C W36-00203 5A W86-00279 2B W86-00051 2H W86-00128 7C W36-00203 5A W86-00281 5B W36-00051 2H W86-00130 7C W36-00207 5G W86-00281								
W86-00042 2F W86-00119 2G W86-00196 3B W86-00273 6D W86-00043 3D W86-00120 2E W86-00198 5A W86-00273 6D W86-00044 2F W86-00121 5A W86-00198 5A W86-00274 6D W86-00045 5B W86-00123 5B W86-00120 5C W86-00275 6D W86-00046 5A W86-00123 5B W86-00124 2E W86-00201 4C W86-00277 6D W86-00048 2D W86-00125 2J W36-00201 4C W86-00277 6D W86-00049 2G W86-00125 2J W36-00203 5A W86-00278 2H W86-00051 2G W86-00125 7C W36-00204 8A W86-00280 8B W86-00212 7C W36-00205 8B W86-00128 7C W36-00205 8B W86-00283 8A W86-00053 5B W86-00130								
W86-00043 5D W86-00120 2E W86-00197 4A W86-00273 6D W86-00044 2F W86-00121 5A W86-00199 2A W86-00274 6D W86-00045 5B W86-00122 5B W86-00199 2A W86-00276 6D W86-00047 5B W86-00123 5B W86-00200 CC W86-00276 6D W86-00048 2D W86-00125 2J W86-00202 6G W86-00277 6D W86-00049 2G W86-00125 2J W86-00203 5A W86-00278 2H W86-00050 2G W86-00125 7C W86-00203 5A W86-00298 6E W86-00051 2H W86-00128 7C W86-00205 8E W86-00281 5B W86-00052 5A W86-00128 7C W86-00205 2H W86-00282 2H W86-00053 5B W86-00130 7C W86-00205 2H W86-00282								
W86-00044 2F W86-00121 5A W86-00198 5A W86-00274 6D W86-00045 5B W86-00123 5B W86-00200 5C W86-00276 6D W86-00047 5B W86-00123 5B W86-00200 5C W86-00276 6D W86-00048 2D W86-00124 2E W86-00202 6G W86-00277 6D W86-00049 2G W86-00125 2F W86-00203 5A W86-00279 2B W86-00050 2G W86-00127 7C W86-00203 5A W86-00279 2B W86-00051 2H W86-00128 7C W86-00205 8E W86-00280 6E W86-00052 5A W86-00129 7C W86-00205 8E W86-00282 2H W86-00053 5B W86-00130 7C W86-00205 3G W86-00282 2H W86-00054 5C W86-00131 6B W86-00208 4A W86-00283								
W86-00045 5B W86-00122 5B W86-00199 2A W86-00276 6D W86-00046 5A W86-00123 3B W86-00200 5C W86-00276 6D W86-00047 5B W86-00124 2E W86-00201 4C W86-00277 6D W86-00049 2D W86-00125 2J W86-00203 5A W86-00279 2B W86-00050 2G W86-00127 7C W86-00204 8A W86-00280 6E W86-00051 2H W86-00128 7C W86-00204 8A W86-00280 6E W86-00051 2H W86-00128 7C W86-00206 2H W86-00281 5B W86-00012 7C W86-00207 5G W86-00281 5B W86-00035 5B W86-00130 7C W86-00207 5G W36-00283 8A W86-00035 5C W86-00132 2F W86-00207 5G W36-00284 8C								
W86-00046 5A W86-00123 5B W86-00200 5C W86-00277 6D W86-00047 5B W86-00124 2E W86-00202 6G W86-00277 6D W86-00049 2D W86-00125 2J W86-00202 6G W86-00278 2H W86-00040 2G W86-00126 2F W86-00203 5A W86-00279 2B W86-00051 2H W86-00128 7C W86-00206 8E W86-00281 5B W86-00051 2H W86-00129 7C W86-00206 2H W86-00281 5B W86-00033 5B W86-00130 7C W86-00206 2H W86-00283 8A W86-00035 5C W86-00131 6B W86-00208 4A W86-00283 8A W86-00035 5C W86-00132 2F W86-00200 5C W86-00283 8A W86-00036 5D W86-00134 5F W86-00210 5C W86-00289								
W86-00047 5B W86-00124 2E W86-00201 4C W86-00277 6D W86-00049 2G W86-00125 2F W86-00203 5A W86-00278 2B W86-00050 2G W86-00127 7C W86-00204 8A W86-00280 6E W86-00051 2H W86-00128 7C W86-00205 8E W86-00281 5B W86-00052 5A W86-00129 7C W86-00206 2H W86-00281 5B W86-00052 5A W86-00129 7C W86-00206 2H W86-00282 2H W86-00053 5B W86-00131 6B W86-00207 5G W86-00283 8A W86-00055 5C W86-00131 6B W86-00209 8A W86-002283 8A W86-00057 5D W86-00133 2J W86-00210 5C W86-002285 5B W86-00058 5D W86-00135 3B W86-00211 6G W86-002285								
W86-00048 2D W86-00125 2J W86-00202 6G W86-00278 2H W86-00030 2G W86-00126 2F W86-00203 5A W86-00279 2E W86-00051 2H W86-00128 7C W86-00205 8E W86-00281 5B W86-00052 5A W86-00129 7C W86-00206 2H W86-00281 18 W86-00033 5B W86-00130 7C W86-00207 5G W86-00283 8A W86-00034 5C W86-00131 6B W86-00208 4A W86-00283 8A W86-00055 5C W86-00132 2F W86-00209 8A W86-00283 8A W86-00055 5C W86-00133 2J W86-00210 5C W86-00285 5B W86-00058 5D W86-00133 2J W86-00211 6E W86-00285 5B W86-00058 5D W86-00135 8B W86-00211 6E W86-00285								
W86-00049 2G W86-00126 2F W86-00203 5A W86-00279 2B W86-00051 2G W86-00127 7C W86-00204 8A W86-00281 5B W86-00051 2H W86-00128 7C W86-00206 2H W86-00281 5B W86-00052 5A W86-00130 7C W86-00206 2H W86-00282 2H W86-00035 5B W86-00130 7C W86-00207 5G W86-00283 8A W86-00035 5C W86-00131 6B W86-00208 4A W86-00284 8C W86-00055 5C W86-00132 2F W86-00210 5C W86-00285 8B W86-00057 5D W86-00134 5F W86-00210 5C W86-00285 7B W86-00058 5D W86-00135 8B W86-00211 6E W86-00289 7D W86-00059 5C W86-00135 6E W86-00213 8A W86-00289								
W86-00050 2G W86-00127 7C W86-0024 8A W86-00280 6E W86-00051 2H W86-00128 7C W86-00205 2E W86-00281 2H W86-00052 5A W86-00130 7C W86-00207 5G W86-00282 2H W86-00035 5C W86-00131 6B W86-00208 4A W86-00283 8A W86-00055 5C W86-00131 6B W86-00208 4A W86-00285 8B W86-00055 5C W86-00133 2J W86-00210 5C W86-00285 8B W86-00057 5D W86-00133 2J W86-00210 5C W86-00286 5B W86-00058 5D W86-00135 8B W86-00211 6E W86-00286 5B W86-00059 5C W86-00136 5G W86-00213 8A W86-00288 5A W86-00060 5G W86-00136 6C W86-00214 2J W86-00289								
W86-00051 2H W86-00128 7C W86-00205 8E W86-00281 3B W86-00003 5A W86-00129 7C W86-00206 2H W86-00228 2H W86-00228 2H W86-00228 2H W86-00238 8A W86-00234 8C W86-00232 2F W86-00209 8A W86-00238 8A W86-00285 5B W86-00210 5C W86-00285 5B W86-00210 5C W86-00285 5B W86-00212 6G W86-00285 5B W86-00212 6G W86-00285 5B W86-00213 8A W86-00288 5A W86-00289 5G W86-00213 8A W86-00289 5G<								
W86-00052 5A W86-00129 7C W86-0026 2H W86-00282 2H W86-00054 5C W86-00130 7C W86-00207 5G W86-00284 8C W86-00055 5C W86-00132 2F W86-00209 8A W86-00285 8B W86-00057 5D W86-00133 2J W86-00210 5C W86-00286 7B W86-00057 5D W86-00134 5F W86-00211 6E W86-00287 4D W86-00058 5D W86-00135 8B W86-00212 6G W86-00288 5A W86-00059 5C W86-00136 5G W86-00213 8A W86-00289 10C W86-00060 5G W86-00137 6E W86-00213 8A W86-00289 10C W86-00061 3B W86-00138 6C W86-00215 5D W86-00290 5G W86-00060 5A W86-00138 6C W86-00216 2B W86-00290								
W86-00053 5B W86-00130 7C W86-00207 5G W86-00233 8A W86-00055 5C W86-00131 6B W86-00208 4A W86-00285 8B W86-00055 5C W86-00132 2F W86-00209 8A W86-00285 8B W86-00056 2L W86-00133 2J W86-00210 5C W86-00286 5B W86-00057 5D W86-00134 5F W86-00211 6E W86-00286 5B W86-00058 5D W86-00136 5G W86-00212 6G W86-00288 5A W86-00059 5C W86-00136 5G W86-00213 8A W86-00288 5A W86-00060 5G W86-00136 6C W86-00213 8A W86-00289 10C W86-00061 3B W86-00136 6C W86-00213 5D W86-00299 7B W86-00062 5A W86-00136 6C W86-00215 5D W86-00299								
W86-00054 SC W86-00131 GB W86-00208 4A W86-00284 BC W86-00056 2L W86-00132 2F W86-00299 8A W86-00285 BB W86-00057 5D W86-00133 2J W86-00211 GE W86-00287 4D W86-00058 5D W86-00135 8B W86-00211 GE W86-00287 4D W86-00059 5C W86-00135 8B W86-00212 GG W86-00289 10C W86-00060 5G W86-00137 6E W86-00214 2J W86-00290 5C W86-00139 6B W86-00215 5D W86-00291 7B W86-00291 7B W86-00061 3B W86-00139 6B W86-00215 5D W86-00291 7B W86-00062 5A W86-00140 6B W86-00217 5C W86-00292 2I W86-00063 5F W86-00141 6B W86-00218 5C W86-00293								
W86-00055 SC W86-00132 2F W86-00299 8A W86-00285 8B W86-00057 SD W86-00133 2J W86-00210 5C W86-00287 4D W86-00057 5D W86-00135 8B W86-00211 6E W86-00287 4D W86-00058 5D W86-00135 8B W86-00212 6G W86-00288 5A W86-00050 5C W86-00136 5G W86-00213 8A W86-00289 1GC W86-00060 5G W86-00137 6E W86-00213 8A W86-00290 5G W86-00138 6C W86-00215 5D W86-00290 5G W86-00061 3B W86-00138 6C W86-00215 5D W86-00291 7B W86-00062 5A W86-00138 6C W86-00216 2B W86-00292 2I W86-00063 5F W86-00140 6B W86-00216 2B W86-00293 3B W86-00293					W86-00207			
W86-00056 2L W86-00133 2J W86-00210 5C W86-00286 5B W86-00058 5D W86-00135 8B W86-00211 6E W86-00288 5A W86-00059 5C W86-00136 5G W86-00213 8A W86-00288 5A W86-00060 5G W86-00137 6E W86-00213 8A W86-00299 10C W86-00061 3B W86-00138 6C W86-00215 5D W86-00299 7B W86-00061 3B W86-00138 6C W86-00215 5D W86-00299 7B W86-00061 3B W86-00140 6B W86-00216 2B W86-00292 2I W86-00063 5F W86-00140 6B W86-00217 5C W86-00294 5B W86-00064 5D W86-00141 6B W86-00217 5C W86-00294 5B W86-00065 2H W86-00143 6E W86-00219 8B W86-00294								
W86-00057 5D W86-00134 5F W86-00211 6E W86-00287 4D W86-00059 5D W86-00135 8B W86-00212 6G W86-00288 5A W86-00060 5G W86-00137 6E W86-00213 8A W86-00299 5G W86-00061 3B W86-00137 6E W86-00215 5D W86-00291 7B W86-00062 5A W86-00139 6B W86-00215 5D W86-00291 7B W86-00063 5F W86-00140 6B W86-00216 2B W86-00293 5B W86-00063 5F W86-00141 6B W86-00218 5C W86-00293 5B W86-00065 5D W86-00142 6C W86-00218 5C W86-00294 5B W86-00065 5F W86-00142 6C W86-00219 8B W86-00294 5B W86-00066 5F W86-00143 6E W86-00221 5D W86-00295								
W86-00058 5D W86-00135 8B W86-00212 6G W86-00288 5A W86-00050 5C W86-00136 5G W86-00213 8A W86-00289 5G W86-00060 5G W86-00137 6E W86-00215 5D W86-00290 5G W86-00061 3B W86-00138 6C W86-00215 5D W86-00291 7B W86-00062 5A W86-00139 6B W86-00216 2B W86-00292 21 W86-00063 5F W86-00140 6B W86-00216 2B W86-00293 5B W86-00063 5F W86-00141 6B W86-00218 5C W86-00293 5B W86-00064 5D W86-00141 6B W86-00218 5C W86-00293 5B W86-00065 2H W86-00142 6C W36-00218 8B W86-00295 5B W86-00065 2H W86-00144 5G W36-00221 5D W36-00295								
W86-00039 SC W86-00136 5G W86-00213 8A W86-00289 10C W86-00000 3G W86-00137 6E W86-00214 2J W86-00290 5G W86-00013 B W86-00138 6C W86-00215 5D W86-00291 7B W86-00062 5A W86-00139 6B W86-00216 2B W86-00291 7B W86-0003 5F W86-00140 6B W86-00217 5C W86-00293 3B W86-00065 5F W86-00141 6B W86-00218 5C W86-00293 3B W86-00065 2H W86-00142 6C W86-00218 5C W86-00295 5B W86-00066 5F W86-00143 6E W86-00220 2E W86-00295 5B W86-00067 2H W86-00144 5G W36-00221 5D W86-00297 5B W86-00069 6A W86-00145 2B W86-00223 8C W86-00299								
W86-00060 5G W86-00137 6E W86-00214 2J W86-00290 5G W86-00061 3B W86-00138 6C W86-00215 5D W86-00291 7B W86-00062 5A W86-00139 6B W86-00216 2B W86-00292 2I W86-00063 5F W86-00140 6B W86-00217 5C W86-00293 5B W86-00065 5D W86-00141 6B W86-00218 5C W86-00294 5B W86-00065 2H W86-00142 6C W86-00219 8B W86-00294 5B W86-00066 5F W86-00143 6E W86-00220 2E W86-00296 5B W86-00067 2H W86-00143 5G W36-00221 5D W86-00296 5B W86-00069 6A W86-00145 5G W36-00222 2B W36-00299 5B W86-00070 6A W86-00147 5C W36-00223 3C W36-00299								
W86-00061 3B W86-00138 6C W86-00215 5D W86-00291 7B W86-00062 5A W86-00139 6B W86-00216 2B W86-00292 21 W86-00063 5F W86-00140 6B W86-00217 5C W86-00293 3B W86-00064 5D W86-00141 6B W86-00218 5C W86-00293 5B W86-00065 2H W86-00142 6C W36-00219 8B W86-00295 5B W86-00066 5F W86-00143 6E W36-00220 2E W36-00296 5B W36-00067 2H W86-00144 5G W36-00221 5D W36-00297 5B W36-00069 6A W36-00145 5G W36-00222 2B W36-00299 5B W36-00070 6A W36-00147 5C W36-00222 2B W36-00299 5B W36-00071 5F W36-00147 5C W36-00224 6G W36-00300								
W86-00062 5A W86-00139 6B W86-00216 2B W86-00292 2I W86-00063 5F W86-00140 6B W86-00217 5C W86-00293 5B W86-00064 5D W86-00141 6B W86-00218 5C W86-00294 5B W86-00065 2H W86-00142 6C W86-00219 8B W86-00295 5B W86-00066 5F W86-00143 6E W86-00220 2E W86-00296 5B W86-00069 1H W86-00144 3G W36-00221 5D W86-00296 5B W86-00068 5G W86-00145 3G W36-00221 5D W86-00298 5B W86-00069 6A W86-00145 3G W36-00223 3C W36-00298 5B W86-00070 6A W86-00146 2B W36-00223 3C W36-00300 5B W36-00071 3F W36-00148 3B W36-00225 3B W36-00300								
W86-0063 SF W86-00140 6B W86-00217 5C W86-00293 3B W86-00065 DD W86-00141 6B W86-00218 5C W86-00294 5B W86-00065 2H W86-00142 6C W86-00219 8B W86-00295 5B W86-00066 5F W86-00143 6E W86-00220 2E W86-00295 5B W86-00067 2H W86-00144 3G W86-00221 3D W86-00297 5B W86-00069 6A W86-00145 5G W86-00222 2B W86-00299 5B W86-00070 6A W86-00146 2B W86-00223 8C W86-00299 5B W86-00071 5F W86-00148 8B W86-00224 6G W86-00300 5B W86-00071 5F W86-00148 8B W86-00225 8B W86-00300 5B W86-00072 5B W86-00148 8B W86-00226 6G W86-00300								
W86-0064 5D W86-00141 6B W86-00218 5C W86-00294 5B W86-00055 2H W86-00142 6C W86-00219 8B W86-00295 5B W86-00060 5F W86-00143 6E W86-00220 2E W86-00295 5B W86-00067 2H W86-00144 5G W86-00221 5D W86-00297 5B W86-00089 5G W86-00145 5G W86-00222 2B W86-00298 5B W86-00099 6A W86-00146 2B W86-00222 2B W86-00299 5B W86-00070 6A W86-00147 5C W86-00224 6G W86-00300 5B W86-00071 5F W86-00148 8B W86-00225 8B W86-00300 5B W86-00072 5B W86-00149 2L W86-00225 8B W86-00300 5B W86-00073 2E W86-00150 2J W86-00227 5A W86-00300								
W86-00065 2H W86-00142 6C W86-00219 8B W86-00295 5B W86-00066 5F W86-00143 6E W86-00220 2E W86-00296 5B W86-00067 2H W86-00144 5G W86-00221 5D W86-00296 5B W86-00088 5G W86-00145 5G W86-00222 2B W86-00298 5B W86-00099 6A W86-00146 2B W86-00223 8C W86-00299 5B W86-00071 5F W86-00148 8B W86-00224 6G W86-00300 5B W86-00072 5B W86-00148 8B W86-00226 6G W86-00301 5B W86-00073 2E W86-00150 2J W86-00227 5A W86-00304 8B W86-00075 2A W86-00151 2J W86-00229 5A W86-00303 3B W86-00076 2E W86-00153 5B W86-00230 5C W86-00306								
W86-0066 5F W86-00143 6E W86-00220 2E W86-00296 5B W86-00072 2H W86-00144 5G W86-00221 5D W86-00297 5B W86-00088 5G W86-00145 5G W86-00222 2B W86-00299 5B W86-00099 6A W86-00146 2B W86-00223 8C W86-00299 5B W86-00070 6A W86-00147 5C W86-00224 6G W86-00300 5B W86-00071 5F W86-00148 8B W86-00225 8B W86-00301 5B W86-00072 5B W86-00149 2L W86-00226 6G W86-00302 5B W86-00073 2E W86-00150 2J W86-00227 5A W86-00303 5C W86-00075 2A W86-00151 2J W86-00229 2B W86-00303 3B W86-00075 2A W86-00152 8A W86-00229 2B W86-00303			******					
W86-00067 2H W86-00144 5G W86-00221 5D W86-00297 5B W86-00069 6A W86-00146 2B W86-00222 2B W86-00299 5B W86-00070 6A W86-00147 5C W86-00224 6G W86-00300 5B W86-00071 5F W86-00148 8B W86-00225 8B W86-00301 5B W86-00072 5B W86-00149 2L W86-00225 6G W86-00302 5B W86-00073 2E W86-00150 2J W86-00227 5A W86-00302 5B W86-00074 2F W86-00151 2J W86-00228 2G W86-00304 8B W86-00075 2A W86-00152 8A W86-00229 2B W86-00305 3B W86-00076 2E W86-00153 3B W86-00229 2B W86-00305 3B								
W86-00068 5G W86-00145 5G W86-00222 2B W86-00298 5B W86-00090 6A W86-00146 2B W86-00223 8C W86-00299 5B W86-00070 6A W86-00147 5C W86-00224 6G W86-00300 5B W86-00148 8B W86-00225 8B W86-00301 5B W86-00072 5B W86-00149 2L W86-00226 6G W86-00302 5B W86-00073 2E W86-00151 2J W86-00227 5A W86-00303 5C W86-00075 2A W86-00151 2J W86-00228 2G W86-00303 3B W86-00076 2E W86-00153 5B W86-00230 5C W86-00306 3B								
W86-00069 6A W86-00146 2B W86-00223 8C W86-00299 5B W86-00070 6A W86-00147 5C W86-00224 6G W86-00300 5B W86-00071 5F W86-00148 8B W86-00225 8B W86-00301 5B W86-00072 5B W86-00149 2L W86-00226 6G W86-00302 5B W86-00073 2E W86-00150 2J W86-00227 5A W86-00303 5C W86-00075 2A W86-00152 2J W86-00228 2G W86-00304 8B W86-00075 2A W86-00152 8A W86-00229 2B W86-00303 3B W86-00076 2E W86-00153 5B W86-00230 5C W86-00306 3B								
W86-00070 6A W86-00147 5C W86-00224 6G W86-00300 5B W86-00071 5F W86-00148 8B W86-00225 8B W86-00300 5B W86-00172 5B W86-00149 2L W86-00226 6G W86-00300 5B W86-00073 2E W86-00150 2J W86-00227 5A W86-00300 3C W86-00074 2F W86-00151 2J W86-00228 2G W86-00300 8B W86-00075 2A W86-00152 8A W86-00229 2B W86-00305 3B W86-00076 2E W86-00153 5B W86-0020 5C W86-00306 3B								
W86-00071 5F W86-00148 8B W86-00225 8B W86-00301 5B W86-00072 5B W86-00149 2L W86-00226 6G W86-00302 5B W86-00073 2E W86-00150 2J W86-00227 5A W86-00303 5C W86-00074 2F W86-00151 2J W86-00228 2G W86-00304 8B W86-00075 2A W86-00152 8A W86-00229 2B W86-00305 3B W86-00076 2E W86-00153 5B W86-00230 5C W86-00306 3B								
W86-0072 5B W86-00149 2L W86-00226 6G W86-00302 5B W86-0073 2E W86-00150 2J W86-00227 5A W86-00303 5C W86-00074 2F W86-00151 2J W86-00228 2G W86-00304 8B W86-00075 2A W86-00152 8A W86-00229 2B W86-00305 3B W86-00076 2E W86-00153 5B W86-00230 5C W86-00306 3B								
W86-00073 2E W86-00150 2J W86-00227 5A W86-00303 5C W86-0074 2F W86-00151 2J W86-00228 2G W86-00304 8B W86-00075 2A W86-00152 8A W86-00229 2B W86-00305 3B W86-00076 2E W86-00153 5B W86-00230 5C W86-00306 3B								
W86-0074 2F W86-00151 2J W86-00228 2G W86-00304 8B W86-0075 2A W86-00152 8A W86-00229 2B W86-00305 3B W86-00076 2E W86-00153 5B W86-00230 5C W86-00306 3B								
W86-0075 2A W86-00152 8A W86-00229 2B W86-00305 3B W86-0076 2E W86-00153 5B W86-00230 5C W86-00306 3B								
W86-00076 2E W86-00153 5B W86-00230 5C W86-00306 3B								
								-

ACCESSION NUMBER INDEX

25	







- NATURE OF WATER
- 2 WATER CYCLE
- WATER SUPPLY AUGMENTATION AND CONSERVATION
- WATER QUANTITY MANAGEMENT AND CONTROL
- 5 WATER QUALITY MANAGEMENT AND PROTECTION
- 6 WATER RESOURCES PLANNING
- 7 RESOURCES DATA
- 8 ENGINEERING WORKS
- 9 MANPOWER, GRANTS, AND FACILITIES
- 10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

NORTH AMERICAN CONTINENT PRICE SCHEDULE

Customers in Canada, United States, and Mexico please use this price schedule; other addressees, write for PR-360-4.

A01\$5.95		
PAPER COPY		
	E01\$7.50	T01\$14
A02 and A03 9.95	E0210.00	T0216
A04 and A05 11.95	£0311.00	T0327
A06 through A09 (inclusive) 16.95	E0413.50	T0437
A10 through A13 (inclusive) 22.95	E0515.50	T0546
A14 through A17 (inclusive) 28.95	£0618.00	T0653
ATE through A21 (inclusive) 34.95	E0720.50	T0761
A22 through A25 (inclusive) 40.95	E0823.00	T0868
A99*	E0925.50	T0976
	E1028.00	T1083
	E1130.50	71191
	E1233.00	T1298
NO145.00	£1335.50	T131,06
NO2	E1438.50	T141,13
	£1542.00	T151,21
	E1646.00	T161,28
	E1750.00	T171,36
	E1854.00	T181,43
	£1960.00	T191,51
	£2070.00	799
	E99*	
*Contact NTIS for price quote.		

024002
UNIV MICROFILM INTL
SERIALS PROC ORD 48106
SERIALS PROC ORD 48106
ANN ARBOR MI 48106

x86090

AN EQUAL OPPORTUNITY EMPLOYER

U.S. DEPARTMENT OF COMMERCE National Technical Information Service 5285 Port Royal Road Springfield, VA 22161

OFFICIAL BUSINESS
Penalty for Private Use,

\$300

001

BULK RATE
POSTAGE & FEES PAID
NTIS
Permit No. G-292

